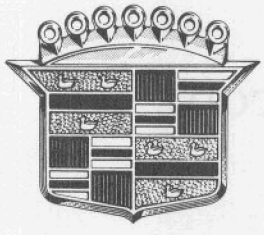


1972 Shop Manual

1972 CADILLAC SHOP MANUAL



Service information pertaining to features exclusive to the Eldorado is provided at the back of the individual sections in this manual. All other service information for the Eldorado is the same as that described in the forward portion of the individual sections.

All information, illustrations, and specifications contained in this manual are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

Service Department
CADILLAC MOTOR CAR DIVISION
General Motors Corporation
Detroit, Michigan 48232

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THE CADILLAC CERTIFIED CRAFTSMAN'S LEAGUE

CADILLAC CRAFTSMAN CODE

I HEREBY pledge myself in all my work on Cadillac cars, to be thorough and exact in diagnosing trouble; to recommend only that service which is to the best interest of the owner; to perform that work for which I am responsible in accordance with Cadillac standards to the best of my ability, and in all my dealings with Cadillac owners, to be courteous, honest, and ethical; and to do everything within my power to further the owner's satisfaction and promote his good will to Cadillac and to my dealer.

The Cadillac Certified Craftsman's League is a program sponsored by Cadillac Motor Car Division for the benefit of authorized dealer's service departments. Participation in the League is open to Cadillac servicemen and partsmen, including department managers and apprentices. Enrollment information is available from the Zone Service Representative.

GENERAL INFORMATION, MAINTENANCE AND LUBRICATION

Foreword

This Shop Manual has been prepared by the Service Department of the Cadillac Motor Car Division to aid in servicing 1972 model Cadillac automobiles. It is intended primarily for servicemen who are familiar with earlier model Cadillacs. It includes complete information on service procedures and specifications pertaining to all 1972 Cadillac cars except Body Service Information which is covered in a separate manual. Refer to the 1972 Body Service Manual for servicing body items on 1972 Cadillac cars.

Arrangement of the Manual

The title page contains a rapid reference section index with headings corresponding to the page tabs at the beginning of each section. A Table of Contents is provided at the beginning of each section that contains more than one major subject. A complete alphabetical index is located at the back of the manual. The section sequence used in this manual has been arranged to conform with the Shop Manuals of other GM car lines. This sequence will enable service personnel of dual dealerships to locate information in technical manuals more easily.

The individual sections include diagnosis and theory of operation at the beginning of each section followed by service adjustments and replacement procedures. An illustrated list of special tools, a torque requirement chart, and specifications are provided at the end of each section.

Service information pertaining only to those features that are exclusive with the Eldorado is provided at the back of the individual sections in the manual. For Eldorado service procedures and recommendations not listed, refer to the forward part of the appropriate section, as these service procedures are similar to those on other 1972 Cadillac cars.

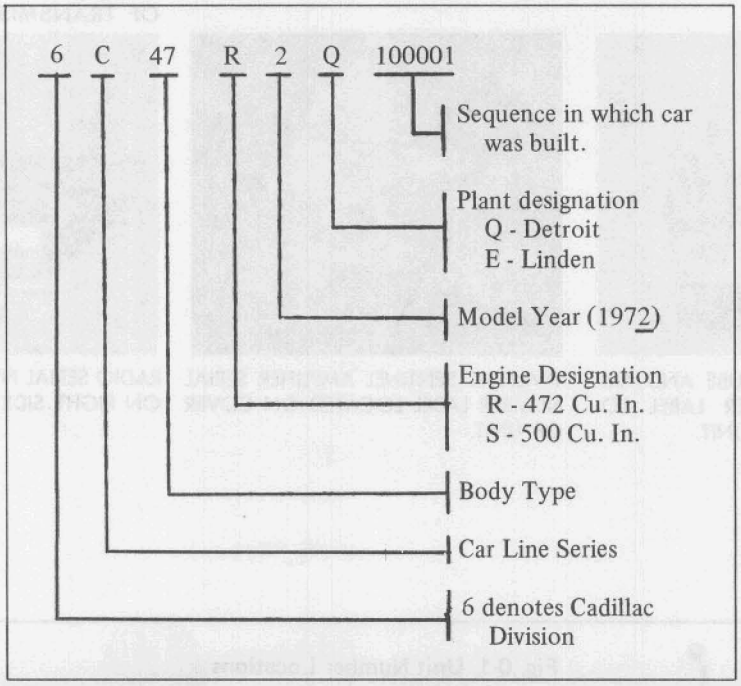
GENERAL INFORMATION

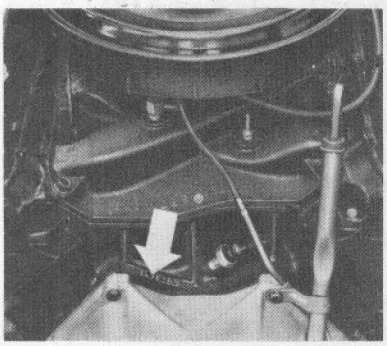
Vehicle Identification Number

Each 1972 Cadillac automobile or commercial chassis carries a 13-digit vehicle identification number used for license and insurance identification and in general reference to the automobile. The number is located on the forward lower edge of the windshield trim molding at the driver's side of the car where it is visible through the windshield. The 1972 Cadillac vehicle identification number is decoded as follows:

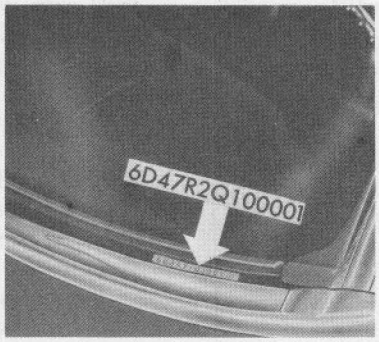
The last six digits of the number determine the sequence in which the car was built. These numbers are utilized as follows:

100001 through 350000 - Detroit built "C" bodies
350001 through 400000 - Linden built DeVille series
400001 through 450000 - Detroit built "E" bodies

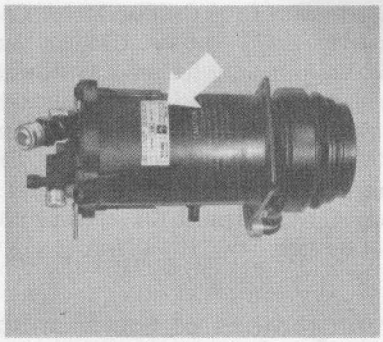




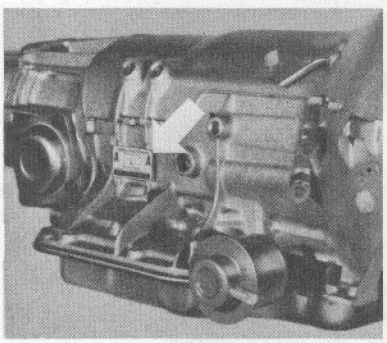
VEHICLE IDENTIFICATION NUMBER DERIVATIVE LOCATED ON LEFT REAR OF CRANKCASE BEHIND INTAKE MANIFOLD.



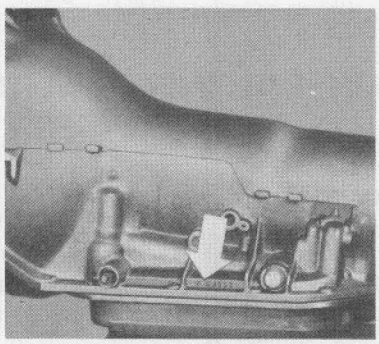
VEHICLE IDENTIFICATION NUMBER LOCATED ON PLATE RIVETED TO COWL BAR IN THE LOWER LEFT HAND CORNER OF THE WINDSHIELD.



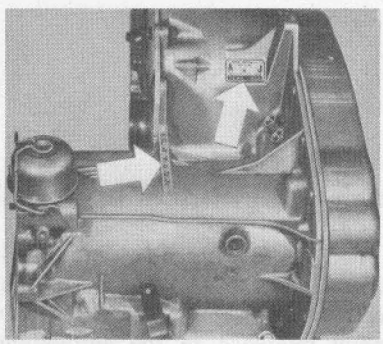
A/C COMPRESSOR SERIAL NUMBER LABEL LOCATED ON REAR PORTION OF COMPRESSOR HOUSING.



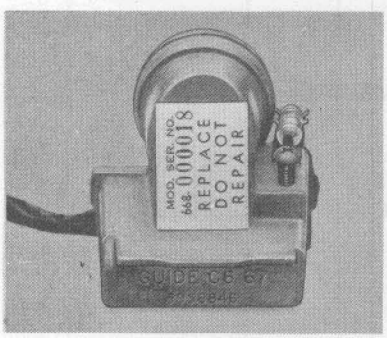
TURBO HYDRA-MATIC TRANSMISSION UNIT NUMBER PLATE LOCATED ON RIGHT SIDE OF CASE (EXCEPT 693).



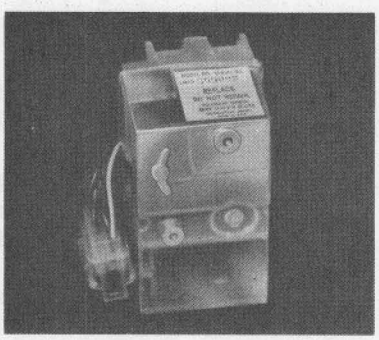
VEHICLE IDENTIFICATION NUMBER DERIVATIVE LOCATED ON LEFT SIDE OF TRANSMISSION CASE (EXCEPT 693).



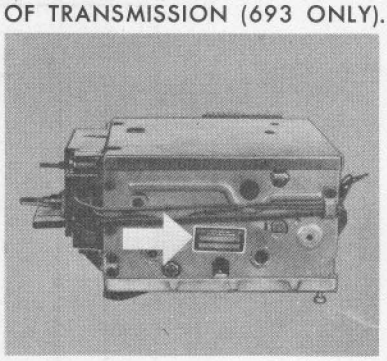
TURBO HYDRA-MATIC TRANSMISSION UNIT NUMBER PLATE LOCATED ON LEFT SIDE OF CONVERTER HOUSING. VEHICLE IDENTIFICATION NUMBER DERIVATIVE LOCATED ON VERTICAL SUPPORT PAD ON LEFT OF TRANSMISSION (693 ONLY).



GUIDE-MATIC PHOTOTUBE AND AMPLIFIER SERIAL NUMBER LABEL LOCATED ON BACK OF UNIT.



TWILIGHT SENTINEL AMPLIFIER SERIAL NUMBER LABEL LOCATED ON COVER OF UNIT.



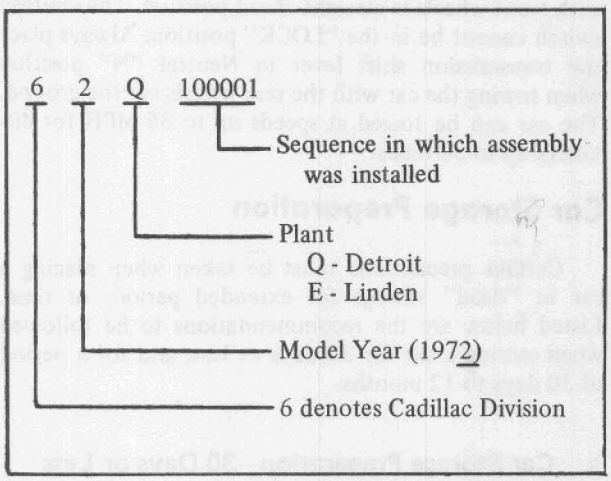
RADIO SERIAL NUMBER TAG LOCATED ON RIGHT SIDE OF TUNER.

Fig. 0-1 Unit Number Locations

MODEL NAME	MODEL DESIGNATOR	VI MODEL NUMBER
Calais Coupe	68247	6C47
Calais Sedan	68249	6C49
Coupe DeVille	68347	6D47
Sedan DeVille	68349	6D49
Fleetwood Sixty Special Brougham	68169	6B69
Fleetwood Seventy-Five Sedan	69723	6F23
Fleetwood Seventy-Five Limousine	69733	6F33
Eldorado Coupe	69347	6L47
Eldorado Convertible	69367	6L67
Commercial Chassis	69890	6Z90

The series and model section (2nd, 3rd and 4th digits) of the vehicle identification number may be further decoded using the above chart. The "model designator" and "VI Model Number" are interchangeable when referring to the automobile.

A nine-digit derivative of the vehicle identification number is applied to the engine and transmission at the locations shown in Fig. 0-1. This derivative is used for in-plant control of these assemblies and may be used by law enforcement or other officials to identify proper engine-chassis combinations. This number should contain the same numbers and letters as the vehicle identification number but in the condensed form shown below.



Identification Numbers

Locations of identification numbers on various units are shown in Fig. 0-1. The identification number on the unit should always appear on product report forms sent to the Central Office such as PIR's, Claim Tags, Pre-Delivery Reports and, when required, on Warranty Claims. The 13 digit Vehicle Identification Number is necessary when reporting product information on any vehicle.

Body Name Plate

A body name plate, Fig. 0-2, is attached to the top surface of the shroud on the right side, under the hood, near the cowl. The name plate carries the style number, trim number, body number and paint number in the areas indicated by ST, TR, BODY and PAINT.

The first two digits of the style number (ST) indicate the model year while the remaining five digits indicate the body style.

The numbers following TR indicate the interior trim color and seat type.

The body number consists of three letters indicating the assembly plant and six digits indicating the sequence in which the body was built.

The first two digits of the paint number indicate color of the body shell and chassis sheet metal; the letter indicates color of convertible and vinyl tops.

The number-letter code at the left below trim indicates date of assembly (month-week).

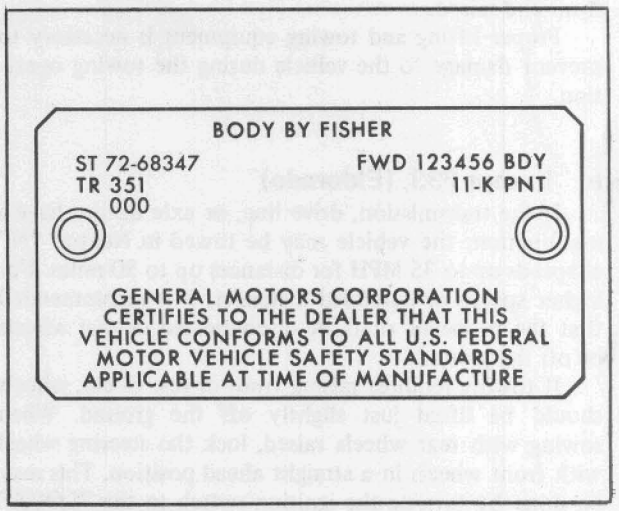


Fig. 0-2 Body Name Plate

GENERAL DESCRIPTION AND SPECIFICATIONS

Description	Style Number	Vehicle Identification Number	Wheelbase (Inches)	Overall Length (Inches)	Overall Height (Inches)	Maximum Width (Inches)	Tread Width	
							Front	Rear
Fleetwood Sixty Special Brougham	68169	6B69	133.0	229.9	55.5	79.8	63.3	63.3
Calais Sedan	68249	6C49	130.0	226.9	54.6	79.8	63.3	63.3
Calais Coupe	68247	6C47	130.0	226.9	54.1	79.8	63.3	63.3
Sedan de Ville	68349	6D49	130.0	226.9	54.6	79.8	63.3	63.3
Coupe de Ville	68347	6D47	130.0	226.9	54.1	79.8	63.3	63.3
Eldorado Coupe	69347	6L47	126.3	222.7	53.9	79.8	63.66	63.59
Eldorado Convertible	69367	6L67	126.3	222.7	54.0	79.8	63.66	63.59
Fleetwood Seventy-Five Sedan	69723	6F23	151.5	248.4	57.8	79.8	63.6	63.3
Fleetwood Seventy-Five Limousine	69733	6F33	151.5	248.4	57.8	79.8	63.6	63.3
Commercial Chassis	69890	6Z90	157.5	253.5	–	–	63.6	65.0

Towing Instructions

1972 Cadillacs cannot be started by pushing, and this procedure should never be attempted. If the car cannot be started in the normal manner, or by use of jumper cables, it should be towed to the nearest authorized Cadillac service facility.

CAUTION: Never use more than a 12-volt auxiliary battery for emergency starts to avoid starter motor damage.

When towing a 1972 Cadillac, the transmission should be in Neutral (N) and the engine ignition should be "OFF", but the Anti-Theft Steering Column Lock should not be in the "Lock" position.

Since the Anti-Theft Steering Column Lock locks the steering and shift mechanisms as well as the ignition system, special provisions are necessary for towing a vehicle when the switch is in "lock" position when the key is not available. It will be necessary to place a dolly under the drive wheels and tow the vehicle with the front end raised.

Proper lifting and towing equipment is necessary to prevent damage to the vehicle during the towing operation.

a. Except 693, (Eldorado)

If the transmission, drive line, or axle do not have a malfunction, the vehicle may be towed in Neutral "N" at speeds up to 35 MPH for distances up to 50 miles. For higher speeds or extended distances, it is recommended that the propeller shaft be disconnected or rear wheels be off the ground.

If towing requires raising front or rear of car, wheels should be lifted just slightly off the ground. When towing with rear wheels raised, lock the steering wheel with front wheels in a straight ahead position. This may be done by turning the ignition switch to the "LOCK" position.

Before towing, check transmission fluid level. Fluid level must be above full mark on the dip stick with engine off. Always tow car with transmission shift lever in Neutral position.

b. 693 (Eldorado) Only

It is recommended that the Eldorado be towed with the front wheels off the ground. In case vehicle damage in the rear wheel area will not permit towing with the front wheels raised, the car can be towed with the rear wheels off the ground. If towing requires raising the rear of the car, the wheels should be raised just slightly off the ground and the steering wheel should be secured with front wheels in straight ahead position. The ignition switch cannot be in the "LOCK" position. Always place the transmission shift lever in Neutral "N" position when towing the car with the rear wheels off the ground. The car can be towed at speeds up to 35 MPH for distances up to 50 miles.

Car Storage Preparation

Certain precautions must be taken when placing a car in "dead" storage for extended periods of time. Listed below are the recommendations to be followed when storing a car for 30 days or less, and for a period of 30 days to 12 months.

a. Car Storage Preparation—30 Days or Less

1. Wash car and inflate tires to 40 pounds pressure.
2. Provide proper cooling system protection.
3. Run engine until completely warmed up; then drain and refill with fresh oil which, according to the label on the can is intended for service "SE".
4. Run engine again with fresh oil until completely warmed up; drive car to place of storage and park. Do not restart again until end of storage period.
5. Be sure parking brake is in released position and car is on level surface.
6. If car is to be stored in a hot area, the fuel tank, lines, pump, filter and carburetor should be drained.

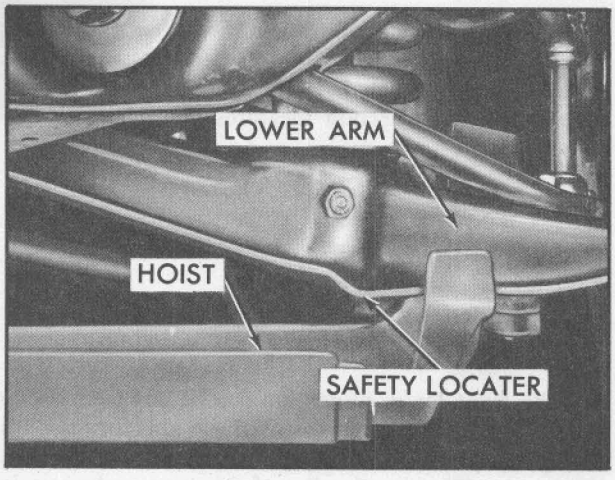


Fig. 0-3 Front Hoist Saddle Position—Except 693

7. Disconnect battery and prevent battery from discharging or freezing by keeping it fully charged.

b. Car Storage Preparation—30 Days to 12 Months

1. Wash car.
2. Run engine until completely warmed up; then drain and refill with fresh oil which according to the label on the can is intended for service "SE".
3. Run engine again with fresh oil until completely warmed up; drive car to storage area. Run engine at 2,000 rpm in neutral and pour engine oil into carburetor. After about a pint has been added, pour oil fast enough to stall engine.
4. Be sure parking brake is in released position and car is on level surface.
5. Drain gasoline from fuel tank.

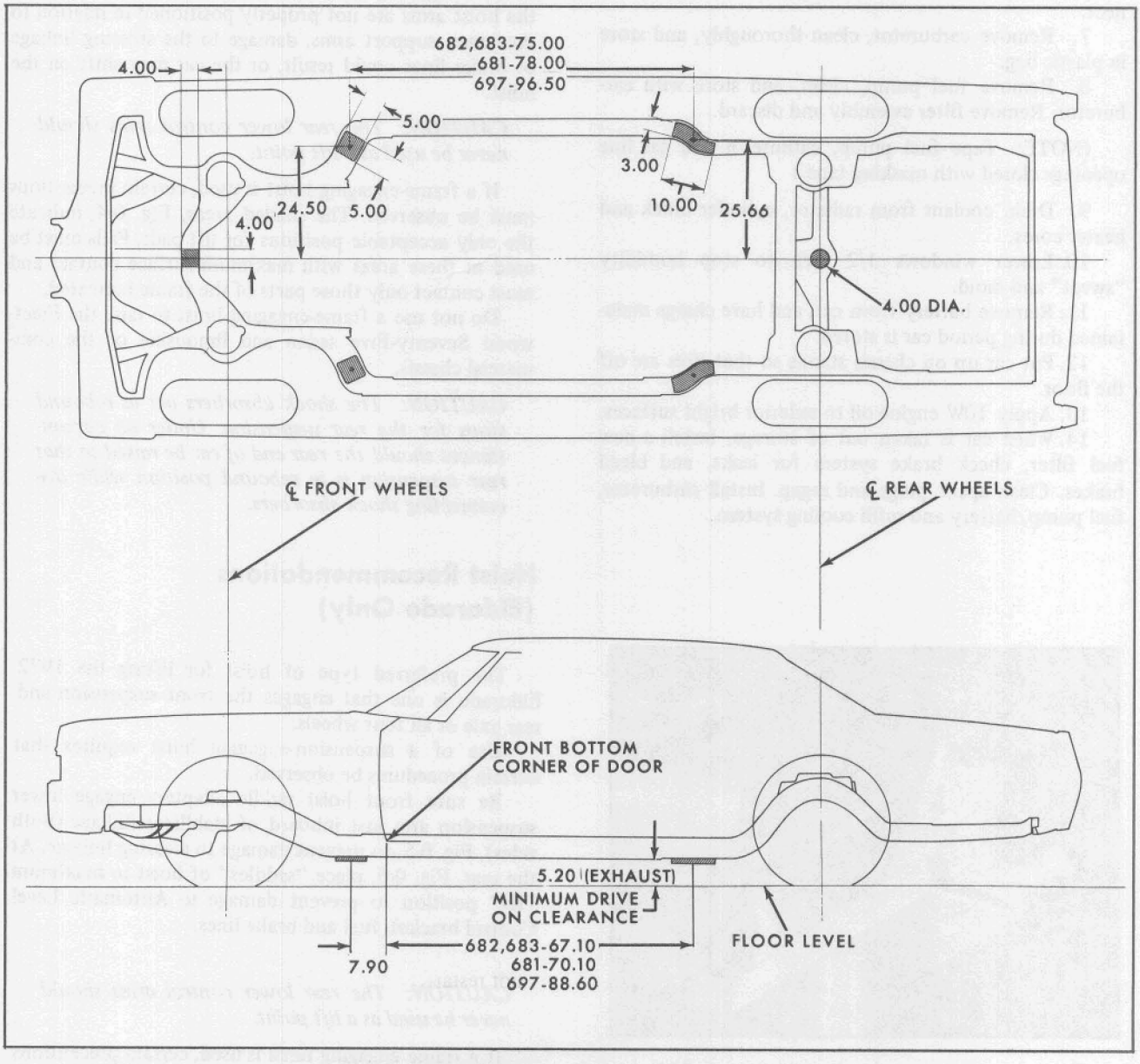


Fig. 0-4 Frame Contact Hoist Position—Except 693, 697 and 698

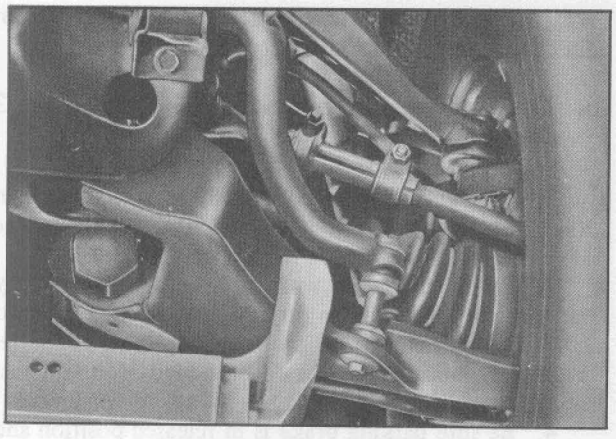


Fig. 0-5 Front Hoist Saddle Position—693

6. Disconnect all fuel lines blow out, and reconnect.

7. Remove carburetor, clean thoroughly, and store in plastic bag.

8. Remove fuel pump, clean, and store with carburetor. Remove filter assembly and discard.

(NOTE: Tape fuel pump, carburetor and gas line openings closed with masking tape.)

9. Drain coolant from radiator, cylinder block and heater cores.

10. Lower windows 1/2 inch to stop humidity "sweat" and mold.

11. Remove battery from car, and have charge maintained during period car is stored.

12. Put car up on chassis stands so that tires are off the floor.

13. Apply 10W engine oil to exterior bright surfaces.

14. When car is taken out of storage, install a new fuel filter, check brake system for leaks, and bleed brakes. Clean spark plugs and regap. Install carburetor, fuel pump, battery and refill cooling system.

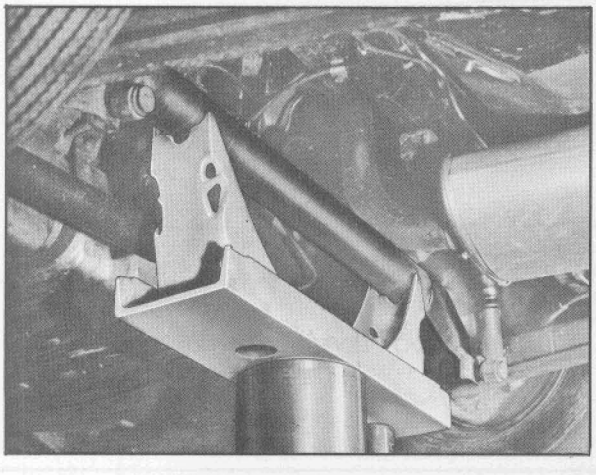


Fig. 0-6 Rear Hoist Saddle Position—693

Special consideration should be given when conditions of high humidity, high temperature, or outdoor storage are encountered. Local experience will dictate the additional protection measures in each particular case.

Hoist Recommendations (Except Eldorado)

The preferred type of hoist for lifting 1972 Cadillacs is one that engages the front suspension and rear axle, or all four wheels.

The front lower suspension arm is designed with a flattened portion on the flange of the arm for use with lifting equipment that engages the suspension system. When using lifting equipment of this type, make certain that the car is properly centered over the hoist and that the hoist arms are positioned under the flattened portion of the flange, Fig. 0-3, outboard of the safety locaters. If the hoist arms are not properly positioned in relation to the lower support arms, damage to the steering linkage or brake lines could result, or the car may shift on the hoist.

CAUTION: The rear lower control arms should never be used as a lift point.

If a frame-engaging hoist is used, certain precautions must be observed. The shaded areas, Fig. 0-4, indicate the only acceptable positions for lift pads. Pads must be used in these areas with maximum surface contact and must contact only those parts of the frame indicated.

Do not use a frame-engaging hoist to raise the Fleetwood Seventy-Five sedan and limousine or the commercial chassis.

CAUTION: The shock absorbers act as rebound stops for the rear suspension. Under no circumstances should the rear end of car be raised so that rear suspension is in rebound position while disconnecting shock absorbers.

Hoist Recommendations (Eldorado Only)

The preferred type of hoist for lifting the 1972 Eldorado is one that engages the front suspension and rear axle or all four wheels.

Use of a suspension-engaging hoist requires that certain procedures be observed.

Be sure front hoist saddle adapters engage lower suspension arm just inboard of stabilizer linkage (both sides), Fig. 0-5, to prevent damage to steering linkage. At the rear, Fig. 0-6, place "saddles" of hoist in maximum "IN" position to prevent damage to Automatic Level Control bracket, fuel and brake lines.

CAUTION: The rear lower control arms should never be used as a lift point.

If a frame engaging hoist is used, certain precautions must also be observed.

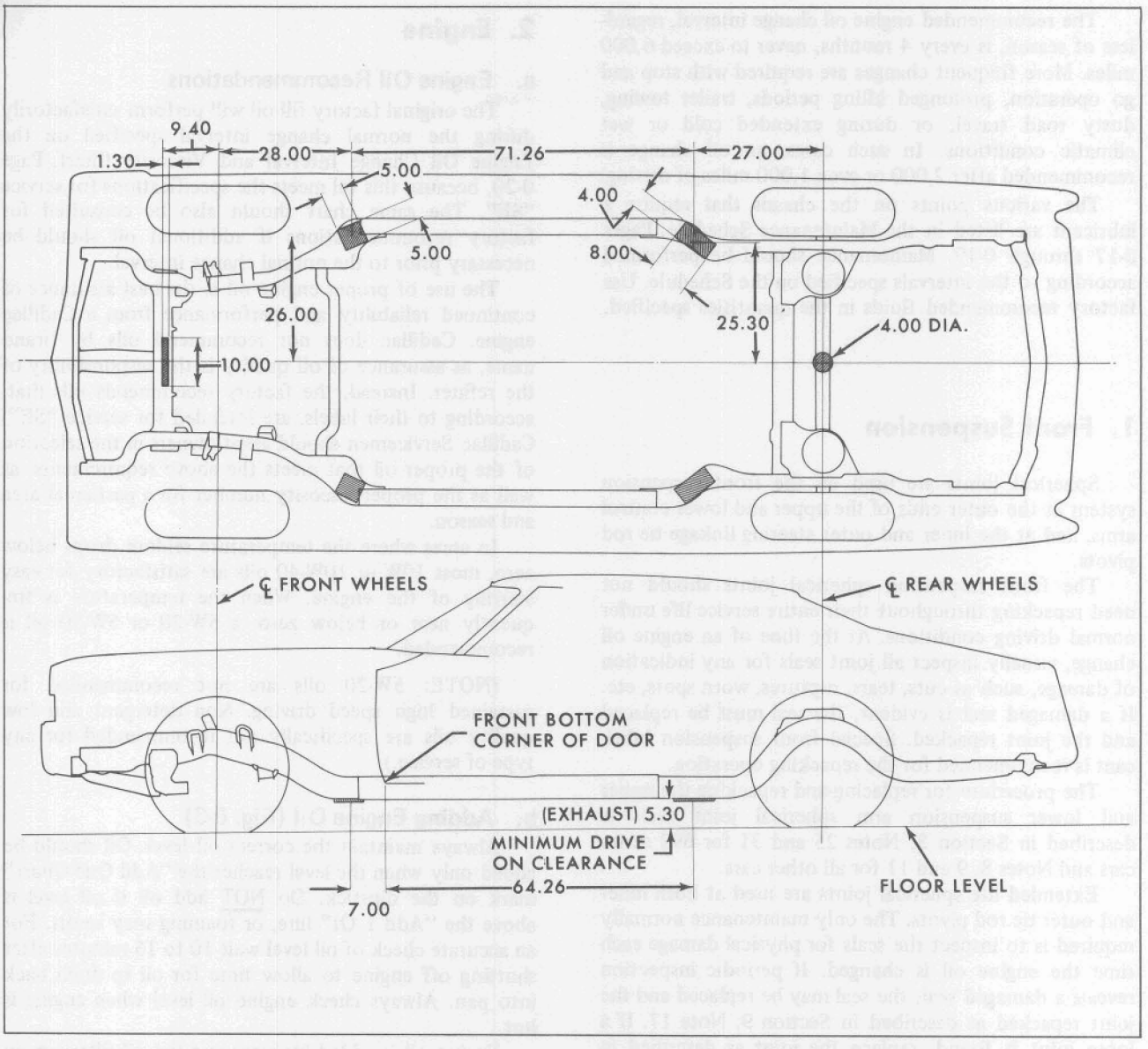


Fig. 0-7 Frame Contact Hoist Position—693

Make sure that hoist adapters and "tabs" are in lowered position before driving on or off the lift.

Position hoist adapter "tabs" in raised position to obtain maximum possible height between frame and hoist.

Be sure to position adapter tabs in exact locations shown in shaded areas of Fig. 0-7 and make sure the centerline of the door is behind the centerline of the lift post for proper weight distribution.

An additional precaution of using two floor stands under the front frame cross member of the Eldorado is recommended when heavy mechanical operations are to be performed. Be sure to remove these stands before attempting to lower the vehicle.

If a drive-on hoist is used, be sure the center line relationship as stated above is also applied (Fig. 0-7).

When supporting the Eldorado with a floor jack or jack stands, the supports should be placed at the suspension lift points or the frame contact lift points. The Eldorado should never be supported at the extreme ends of the frame or at the center of the frame side rail or lifted at the front or rear bumper with anything other than the bumper jack provided with the car.

SERVICE INFORMATION

Complete instructions for lubrication of the various points of the 1972 Cadillacs are described in this section. An Engine Oil Change Interval and Viscosity Chart, and a Fluid Capacity Chart appear at the end of this section, on page 0-20. The Maintenance Schedule, Pages 0-17 through 0-19, is based upon service at time of engine oil change, unless otherwise specified.

The recommended engine oil change interval, regardless of season, is every 4 months, never to exceed 6,000 miles. More frequent changes are required with stop and go operation, prolonged idling periods, trailer towing, dusty road travel, or during extended cold or wet climatic conditions. In such cases, an oil change is recommended after 2,000 or even 1,000 miles of driving.

The various points on the chassis that require a lubricant are listed in the Maintenance Schedule. Pages 0-17 through 0-19. Maintenance should be performed according to the intervals specified on the Schedule. Use factory recommended fluids in the quantities specified.

1. Front Suspension

Spherical joints are used on the front suspension system at the outer ends of the upper and lower control arms, and at the inner and outer steering linkage tie rod pivots.

The front suspension spherical joints should not need repacking throughout their entire service life under normal driving conditions. At the time of an engine oil change, visually inspect all joint seals for any indication of damage, such as cuts, tears, ruptures, worn spots, etc. If a damaged seal is evident, the seal must be replaced and the joint repacked. Special front suspension lubricant is recommended for the repacking operation.

The procedure for replacing and repacking the upper and lower suspension arm spherical joint seals is described in Section 3, Notes 25 and 31 for 693 series cars and Notes 8, 9 and 11 for all other cars.

Extended life spherical joints are used at both inner and outer tie rod pivots. The only maintenance normally required is to inspect the seals for physical damage each time the engine oil is changed. If periodic inspection reveals a damaged seal, the seal may be replaced and the joint repacked as described in Section 9, Note 17. If a loose joint is found, replace the joint as described in Section 9, Notes 16 and 28.

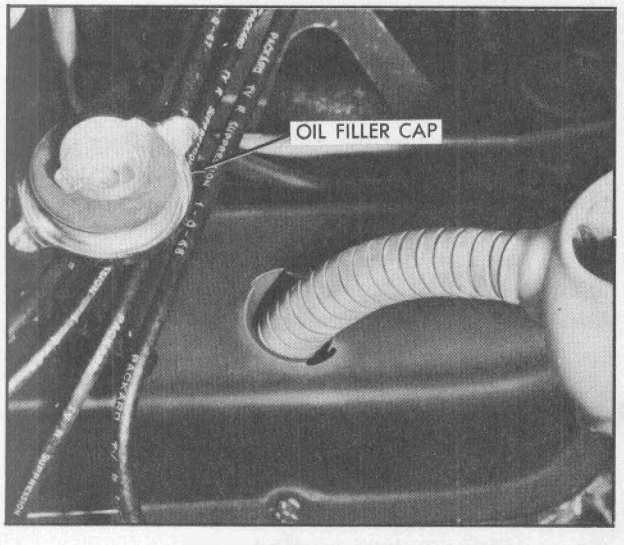


Fig. 0-8 Adding Engine Oil

2. Engine

a. Engine Oil Recommendations

The original factory fill oil will perform satisfactorily during the normal change interval specified on the Engine Oil Change Interval and Viscosity Chart, Page 0-20, because this oil meets the specifications for service "SE". The same chart should also be consulted for factory recommendations if additional oil should be necessary prior to the normal change interval.

The use of proper engine oil is the best assurance of continued reliability and performance from a Cadillac engine. Cadillac does not recommend oils by brand name, as assurance of oil quality is the responsibility of the refiner. Instead, the factory recommends oils that, according to their labels, are intended for service "SE". Cadillac Servicemen should assist owners in the selection of the proper oil that meets the above requirements, as well as the proper viscosity number for a particular area and season.

In areas where the temperature seldom drops below zero, most 10W or 10W-40 oils are satisfactory for easy starting of the engine. When the temperature is frequently near or below zero, a 5W-20 or 5W-30 oil is recommended.

(NOTE: 5W-20 oils are not recommended for sustained high speed driving. Non detergent and low quality oils are specifically not recommended for any type of service.)

b. Adding Engine Oil (Fig. 0-8)

Always maintain the correct oil level. Oil should be added only when the level reaches the "Add One Quart" mark on the dipstick. Do NOT add oil if oil level is above the "Add 1 Qt" line, or foaming may result. For an accurate check of oil level wait 10 to 15 minutes after shutting off engine to allow time for oil to drain back into pan. Always check engine oil level when engine is hot.

Engine oil is added by removing the oil filler cap on the right rocker arm cover, Fig. 0-8.

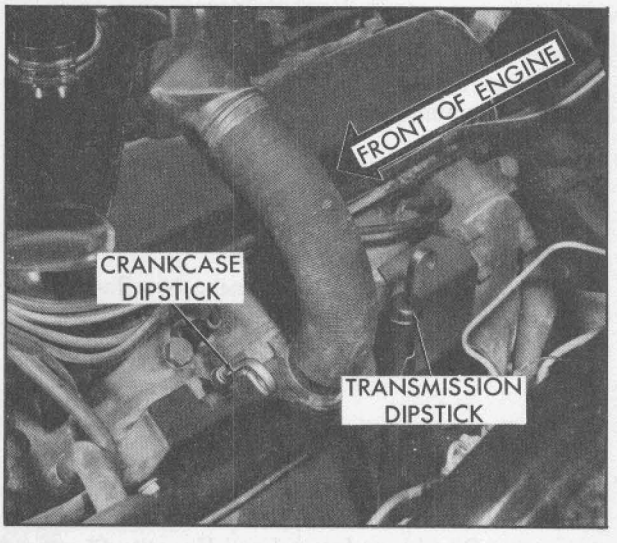


Fig. 0-9 Dipstick Locations—693

c. Changing Engine Oil

The crankcase should be drained only after the engine has been warmed to normal operating temperature. The benefits of draining are minimized if the crankcase is drained when the engine is cold, as some suspended foreign matter will cling to the internal engine parts and will not drain with the slower moving colder oil.

The Engine Oil Change Interval and Viscosity Chart, Page 0-20, will serve as a guide for the proper oil change interval and oil viscosity to be used at the prevailing temperature. It is unnecessary to change the oil for the occasional unseasonably cold or warm day encountered during the fall or spring season.

The crankcase capacity is 4 quarts (5 quarts on Eldorado). Do not add more than 4 quarts except when changing oil filter in which case 5 quarts should be used (6 quarts on Eldorado).

The dipstick locations for the Eldorado are shown in Fig. 0-9.

(NOTE: The Eldorado engine has 2 oil pan drain plugs which must be opened when changing oil.)

3. Engine Accessories

a. Distributor

The Cadillac distributor is permanently lubricated and requires no periodic oiling. However, in the event the distributor is disassembled and the shaft or breaker plate is removed, the wick in the oil reservoir should be moistened with light weight engine oil.

When the contact point set is changed, the distributor cam lubricator should be rotated 1/2 turn. At the second engine tune up, 24,000 miles, the lubricator should be replaced. Rotate or replace lubricator with each engine tune-up.

b. Carburetor Air Cleaner

The carburetor air cleaner, Fig. 0-10, incorporates a replaceable paper element. A new air cleaner element should be installed every 24,000 miles. More frequent replacement of the element may be necessary if the car is constantly driven in dusty areas. A visual inspection of

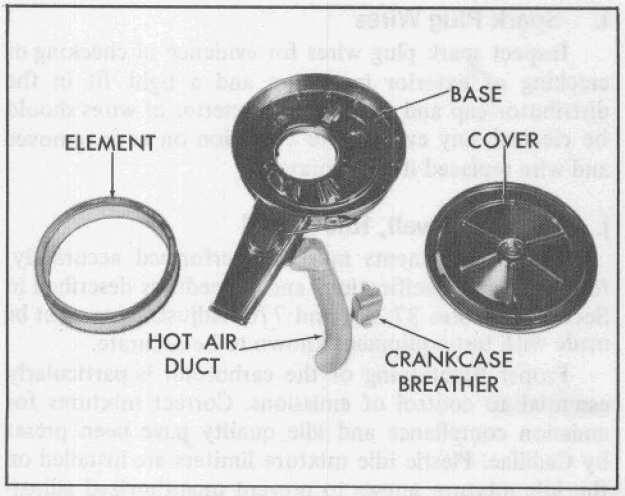


Fig. 0-10 Thermac Air Cleaner Assembly



Fig. 0-11 Engine Oil Filter

the element is recommended every 12 months or 12,000 miles, to make certain that it is properly seated and that there is no indication of dust leakage. If dirt or damage is indicated at time of visual inspection, the element should be changed. To replace element, proceed as follows:

1. Remove cover from carburetor air cleaner.
2. Remove element and discard.
3. Wipe all dirt from inside air cleaner cover.
4. Install a new element on air cleaner base, making certain that it is properly seated and replace air cleaner cover.

c. Engine Oil Filter (Fig. 0-11)

The engine oil filter is of the spin-on, full-flow type. It is recommended that the filter be replaced at time of first engine oil change and every second oil change thereafter.

The full-flow type oil filter filters 100% of the oil delivered by the oil pump. For this reason, it is very important that the recommended oil filter change intervals be followed.

The oil filter is mounted on the front right side of the engine, Fig. 0-11. Access to the filter is gained from under the car. Replacement procedure is as follows:

1. Position car on hoist.
2. Unscrew filter from base and discard.
3. Wipe gasket area of base clean.
4. Place a light film of silicone on top of gasket and screw filter on stud of filter base by hand until gasket touches filter base. Then tighten element and additional 2/3 of a turn.
5. Add 1 quart of oil to engine crankcase.

(NOTE: If engine oil is changed in conjunction with oil filter replacement, add a total of 5 quarts of oil to engine crankcase (6 on Eldorado).)

6. Operate engine at fast idle and check for oil leaks at filter base.

7. After engine has run for 3 to 4 minutes, stop engine and check oil level.

4. Battery

The battery electrolyte level should be checked at every engine oil change. In warm weather, a check should be made at two-week intervals. An electrolyte level indicator vent cap is located in the second cell cap from the positive battery terminal.

The indicator cap makes it unnecessary to remove cell vent caps when checking fluid level. A dark (black) spot in the center of this vent cap is visible when electrolyte is at the normal level.

If at any time the electrolyte level drops below normal, the spot changes from black to an off-white color. When an off-white condition is encountered, all cell fluids must be adjusted to their correct level. This is accomplished by adding colorless, odorless drinking water to raise the fluid level to the bottom of the slot in each vent-well.

CAUTION: Do not overfill battery or add any substance to fluid except colorless, odorless drinking water.

The Eldorado uses a side terminal battery. When replacing battery cables retorque screws to 70 inch-pounds.

CAUTION: Over torquing terminal screws may strip threads in terminal or short out battery. Use only proper size (3/8 x 16 coarse).

Keep battery, cable clamps and hold-down bracket clean. If necessary, clean with a solution of ammonia and water, or baking soda and water. Flush off with water and apply petroleum jelly to cable clamps and terminals to retard corrosion.

5. Emission Controls Maintenance

The Federal Clean Air Act stipulates that it is unlawful "for any person to remove or render inoperative any device or element of design on a motor vehicle in compliance with regulations." A further provision stipulates that "the manufacturer shall furnish with each new Motor vehicle" . . . "written instructions for the maintenance and use of the vehicle or engine by the ultimate purchaser as may be reasonable and necessary to assure the proper functioning of emission control devices and systems."

a. Thermac Air Cleaner

The thermac air cleaner should be inspected to make certain that all hoses and ducts are intact and correctly installed. Operational function should be checked as described in Section 6, Note 94.

b. Choke

Choke mechanism should be checked for free operation. A binding condition may have developed from gum formation on the choke shaft or from damage. Choke shafts can usually be cleaned without disassembly by using X-66 Carburetor Conditioner or equivalent.

c. Bolts, Carburetor to Manifold

Carburetor attaching bolts and nuts should be carefully adjusted to correct torque to compensate for compression of gasket at first 4 months or 6,000 miles of vehicle operation only.

d. Fuel Filter

A clogged fuel pump filter may restrict fuel flow. Replace filter each 12 months or 12,000 miles whichever occurs first.

e. Spark Plugs

Spark plugs must be replaced at 6,000 miles when operating with leaded fuels or at 12,000 miles when using unleaded fuels.

Use of leaded fuels results in lead deposits on spark plugs and can cause misfiring. Where misfiring occurs prior to 6,000 miles, spark plugs in good condition can often be cleaned, tested and reinstalled in an engine with acceptable results.

f. Engine Compression

Minimum compression recorded in any one cylinder should not be less than 70% of highest cylinder.

This test should be performed to provide reasonable assurance that engine condition is sufficiently efficient to prevent leakage of unburned gases.

g. Distributor Points, Cam Lubricator

Distributor points should be inspected prior to performance of tune-up adjustments. Burned or pitted points must be replaced. Points in good condition may be reused after readjustment and the rotation or installation of the cam lubricator. New points and cam lubricator should be installed at least every 24,000 miles.

h. Distributor Cap

The interior and exterior of the distributor cap should be carefully inspected and cleaned to prevent misfiring and deterioration.

i. Spark Plug Wires

Inspect spark plug wires for evidence of checking or cracking of exterior insulation and a tight fit in the distributor cap and spark plugs. Exterior of wires should be cleaned, any evidence of corrosion on ends removed and wire replaced if deteriorated.

j. Timing, Dwell, Idle Speed

These adjustments must be performed accurately, following the specifications and procedures described in Section 6, Notes 37, 38, and 77b. Adjustments must be made with test equipment known to be accurate.

Proper functioning of the carburetor is particularly essential to control of emissions. Correct mixtures for emission compliance and idle quality have been preset by Cadillac. Plastic idle mixture limiters are installed on the idle mixture screws to prevent unauthorized adjustment.

These idle limiters are not to be removed unless made necessary by some major carburetor repair or replacement which affects the idle screw adjustment. Thereafter, the idle mixture must be readjusted as described in Section 6, Note 82, and a new red plastic limiter installed.

k. Thermal Vacuum Switch & Hoses

The thermal vacuum switch should be tested as described in Section 6, Note 31a. Vacuum control hoses must be in good condition, correctly installed and fit tightly.

l. Speed Controlled Spark Switch

This switch should be tested as described in Section 6, Note 31b.

m. Evaporation Control System Fuel & Vapor Lines

All fuel and vapor lines and hoses must be in good condition with no signs of leakage. Any damaged or deteriorated lines or hoses must be replaced. All lines should be inspected for proper connections and correct routing.

n. Evaporation Control System Canister

Check canister for cracks or damage when replacing the canister filter. Replace parts as necessary.

o. Evaporation Canister Filter

Remove canister and replace filter in lower section of canister.

p. Positive Crankcase Ventilation Valve

Replace the PCV valve at 24 months or 24,000 mile intervals (whichever occurs first). PCV valve hose, when removed for valve replacement, should be blown out with an air hose to make certain that it is clean. The PCV valve should be replaced at 12 months or 12,000 miles (whichever occurs first) when the vehicle is used under the following conditions:

- Driving in dusty conditions
- Extensive idling
- Trailer towing
- Short trip operation at freezing temperatures (engine not thoroughly warmed-up)

q. Positive Crankcase Ventilation System – Hose, Connections and Crankcase Ventilating Breather

The PCV system should be checked for satisfactory operation at 12-month or 12,000-mile intervals using a tester such as CT-3.

Cleaning of the crankcase ventilating breather is important in order to provide proper crankcase breathing. The breather is located on the left rocker arm cover. The filtering material in the unit must be cleaned with solvent at every oil filter change. Do not oil the filtering element.

r. Air Injection Reactor Pump & Engine Drive Belts

Engine belts must be properly adjusted. A slipping belt will not operate the AIR pump satisfactorily. Deteriorated belts should be replaced.

s. Air Injection Reactor System Hoses & Connections

Check AIR system hoses and fittings for loose connections and deterioration. Test diverter valve by quickly depressing and releasing throttle and holding hand under diverter valve exhaust. If exhausted air can be felt during engine deceleration, valve is operating properly. Inoperative diverter valves should be replaced.

t. Test Coolant Level

Engine coolant should be checked for proper level and for corrosion protection to at least -40°F and for freeze protection to the lowest temperature expected during the period of vehicle operation. Each two years or 24,000 miles, whichever first occurs, cooling system must be drained, flushed and refilled with a new coolant solution. See Section 6, Note 4, for additional details on cooling system care.

u. Radiator Core Exterior

For proper cooling efficiency, the exterior of the radiator core and A/C condenser, if so equipped, must be kept clean. Light brushing and reverse air flow is usually a satisfactory cleaning method. Insects can usually be removed with a garden hose using light water pressure.

v. Fuel Cap, Fuel Lines & Fuel Tank

The fuel tank, cap and lines should be inspected for road damage which could cause leakage. Inspect fuel cap for correct sealing ability and indications of physical damage. Replace any damaged or malfunctioning parts.

w. Automatic Transmission Fluid

Oil level in the automatic transmission must be checked at each engine oil change. Under normal driving conditions the transmission fluid should be changed every 24,000 miles. Under unusual conditions such as constant driving in heavy city traffic during hot weather, trailer towing, etc. fluid should be changed at 12,000-mile intervals. It is important that transmission fluid level be maintained at the full mark and not over filled. See Section 7, Note 6, for additional details on transmission care.

6. Power Steering

The steering gear is lubricated by the power steering fluid and requires no other lubricant. The fluid level in the pump reservoir, Fig. 0-12, should be checked every spring and fall after the engine is warm, and the reservoir kept filled with special power steering fluid, part number 1050017, or its equivalent. If the dipstick indicates that the fluid level is extremely low, the unit should be inspected for leaks and corrected immediately. When adding fluid, always use special power steering fluid. Refer to Section 9, Note 1, for checking fluid level.

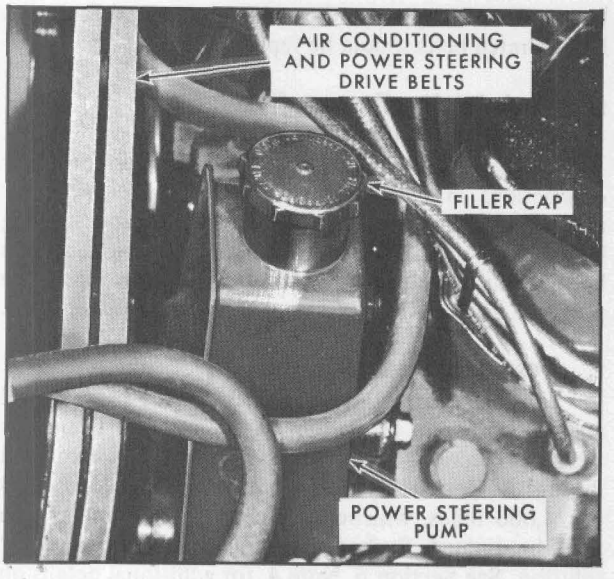


Fig. 0-12 Power Steering Reservoir

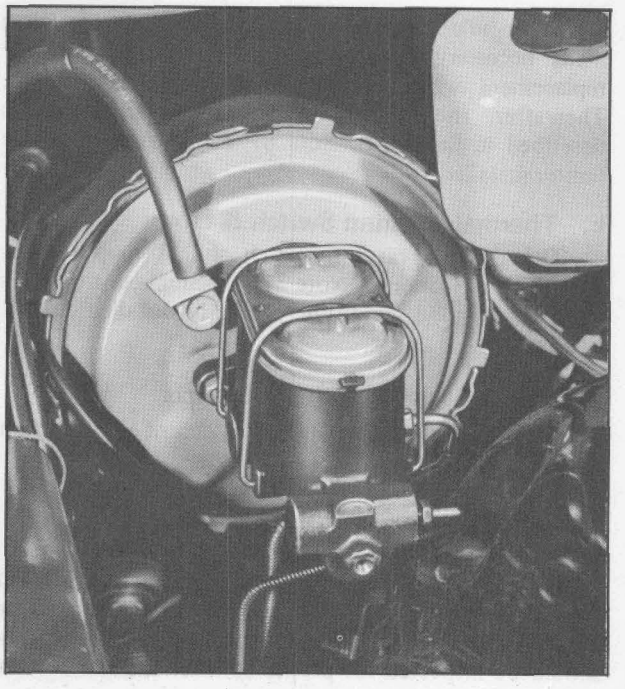


Fig. 0-13 Power Brake Reservoir

7. Power Brakes

The brake fluid level of both sections of the master cylinder, Fig. 0-13 should be checked at every engine oil change and every time the brakes are serviced. The reservoir cover incorporates a diaphragm that provides a seal between the reservoir fluid and the atmosphere to prevent moisture absorption or dust contamination.

If either the front or rear brake reservoir is found to be low, the related hydraulic system should be checked for leaks. Then fill the reservoir with Super Heavy Duty Brake Fluid, part number 5464831, or equivalent fluids conforming to SAE J-1703 specifications, to within 1/8 inch to 3/8 inch of the reservoir sealing surface.

Check travel of service brake pedal and the parking brake pedal every 4 months never to exceed 6,000 miles. Excessive brake pedal travel is an indication of the air in

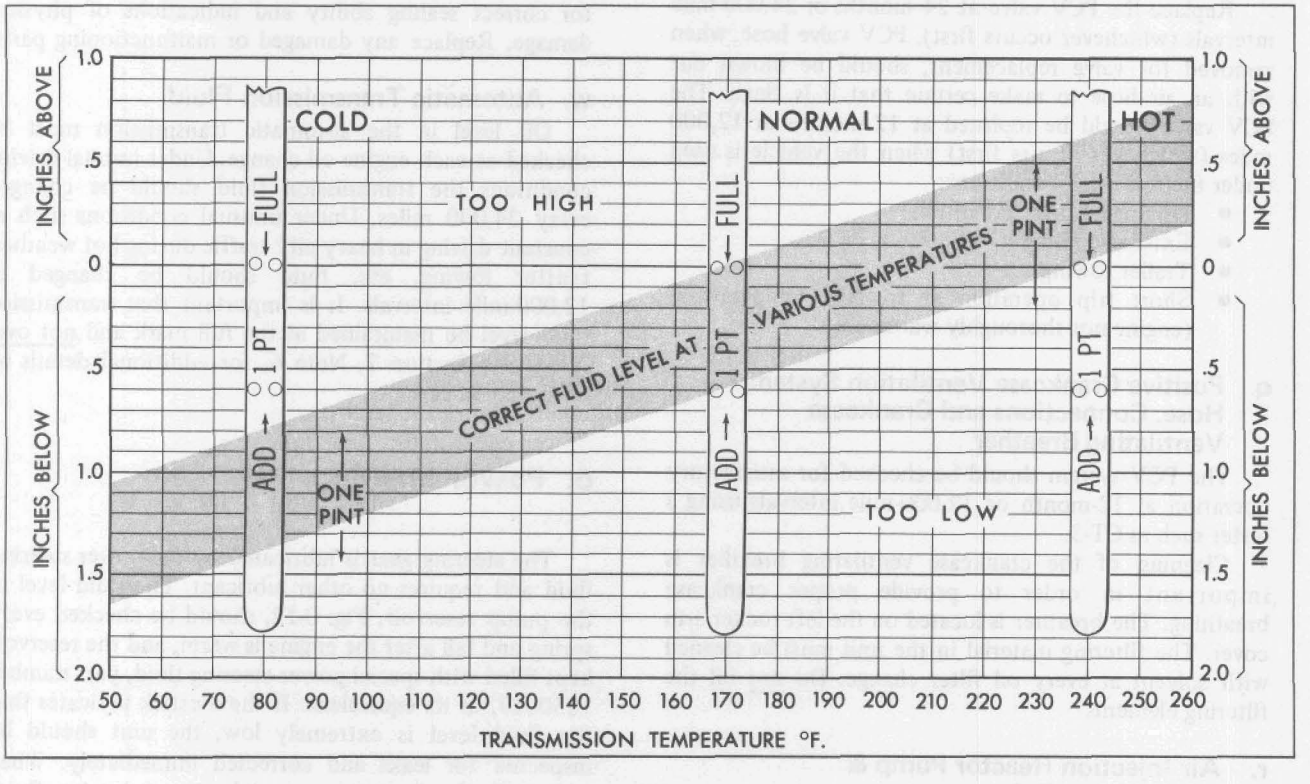


Fig. 0-14 Transmission Oil Level—Except 693

the fluid or some other brake system malfunction.

Service brake pedal travel should not exceed 1-3/4 inch during normal brake pedal application of approximately 30 pounds force (2" on Eldorado). The parking brake pedal should travel 1-3/4 inch to 2-3/4 inch with moderate application (50 pounds force).

Refer to Section 5 for adjustment procedures should either pedal travel be found incorrect.

8. Air Conditioner Compressor

The 6 cylinder compressor uses 525 viscosity oil. It is important that only the type of oil recommended by the compressor manufacturer be used. Refer to Section 1, Note 46 for lubricating recommendations.

9. Transmission

a. Fluid Recommendations

"DEXRON" ® Type Automatic Transmission Fluid or fluid of equivalent quality is recommended exclusively for use in Cadillac automatic transmissions. It should be used both for adding and refilling. "DEXRON" ® fluid or its equivalent incorporates additives not used in regular fluid-additives that are essential for satisfactory transmission performance. Fluid of this quality is distributed by General Motors and by other oil marketers.

b. Checking Fluid Level

The transmission dipstick and filler tube is located on the right side of the engine (left side on the Eldorado, Fig. 0-9).

Fluid level should be checked at every engine oil change. Add fluid, if necessary, until proper level is indicated on dipstick. Proper fluid level is based on operating temperature. See Figs. 0-14 and 0-15. At normal operating temperature, 1 pint of fluid will change the level from the low mark to the full mark on the dipstick.

When checking fluid level, first run engine at 800 rpm with shift lever in Park "P" position for 1-1/2 minutes to make certain converter is full. Reduce engine speed to slow idle, remove and wipe dipstick, then check fluid level. With the engine still running, add fluid through dipstick tube to bring fluid to proper level.

CAUTION: Do not overfill, as foaming may occur when fluid heats up. If fluid level is too low, especially when cold, complete loss of drive may result after quick stops. Extremely low fluid levels will result in damage to the transmission.

c. Transmission Fluid Change

The transmission bottom pan should be drained every 24,000 miles and fresh fluid added to obtain the proper level on the dipstick. For cars subjected to heavy city driving, or in commercial use where the engine is regularly idled for prolonged periods, the bottom pan should be drained every 12,000 miles.

1. Remove dipstick from filler tube and insert a length of hose secured to a suction gun down the filler tube. Remove enough transmission fluid so that bottom pan will not overflow when removed.
2. Raise car and remove bottom pan. Empty pan and clean with solvent.
3. Install bottom pan using a new gasket.

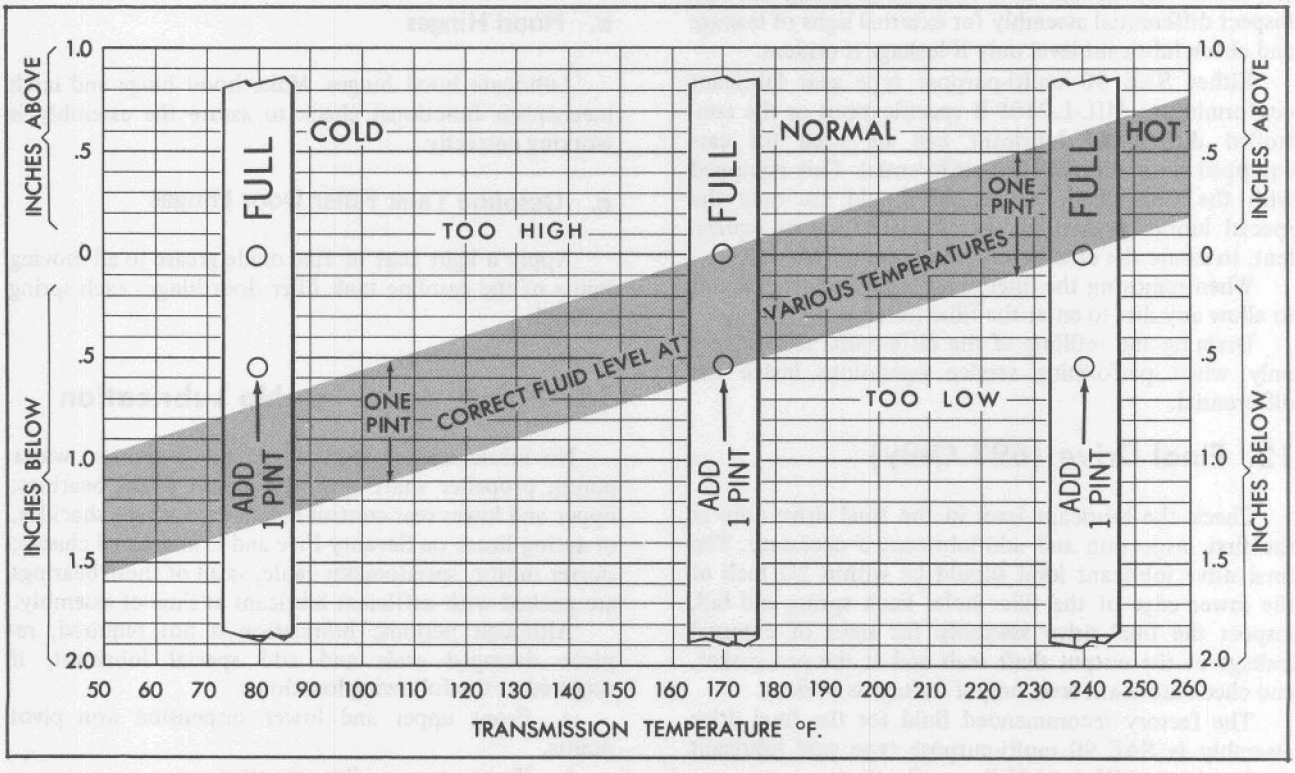


Fig. 0-15 Transmission Oil Level—693

4. Lower car and add 2 quarts of transmission fluid through filler tube.

5. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.

6. Reduce engine speed to slow idle and check fluid level. Add fluid, if necessary, to bring to proper level, Fig. 0-14 and 0-15.

d. Oil Filter

The oil intake system incorporates an oil filter in the transmission oil sump. The filter must be replaced after the first 24,000 miles only, or after a major transmission failure. The procedure for removing and installing the filter is described in Section 7, Note 6c.

e. Transmission Linkage

Lubricate all transmission linkage friction points each spring and fall with a grade 3 zinc oxide grease (except Eldorado). Lubricate Eldorado linkage with a grade 2 lithium soap grease.

10. Front Wheel Bearings (Except 693) Rear Wheel Bearings (693 Only)

These wheel bearings require repacking and adjusting when the brake linings or pads are replaced. When repacking these bearings, use a #2 grade lithium high melting point wheel bearing grease free from any fillers or abrasives. Refer to Section 3, Note 17 for repacking procedure.

11. Differential (Except 693)

Check the lubricant level in the differential only on the first inspection and add lubricant if necessary. The differential lubricant level should be within 1/2 inch of the lower edge of the filler hole. Each spring and fall, inspect differential assembly for external signs of leakage and check lubricant level only if leakage is evident.

Either SAE 90 multi-purpose type gear lubricant conforming to MIL-L-2105-B specifications or the controlled differential lubricant can be used for cars equipped with the standard differential. Cars equipped with the Controlled Differential should use only the special lubricant, part number 1050189, or its equivalent, to assure the satisfactory operation of this unit.

When removing the filler plug, take extreme care not to allow any dirt to enter the filler hole.

Draining and refilling of the differential is necessary only when performing service operations inside the differential.

12. Final Drive (693 Only)

Check the lubricant level in the final drive only at the first inspection and add lubricant if necessary. The final drive lubricant level should be within 1/2 inch of the lower edge of the filler hole. Each spring and fall, inspect the final drive assembly for signs of external leakage at the output shaft seals and at the pan gasket, and check lubricant level only if leakage is evident.

The factory recommended fluid for the final drive assembly is SAE 90 multi-purpose type gear lubricant conforming to MIL-L-2105-B specifications.

When removing the filler plug, take extreme care not to allow any dirt to enter the filler hole.

Draining and refilling of the final drive is necessary only at time of replacement.

13. Propeller Shaft

The propeller shaft does not require maintenance on a regularly scheduled basis. Whenever the shaft is disconnected at the transmission, lubricate the outside diameter of the front propeller shaft yoke with Automatic Transmission Fluid, and the inside diameter with propeller shaft slip yoke lubricant, or an equivalent lubricant.

14. Additional Lubrication Points

The moveable mechanical parts of the body are lubricated during production to insure proper and quiet operation. If additional lubrication is required, lubricants should be used according to the directions in Section 2 of the Body Service Manual.

In addition the following points should be lubricated as indicated.

a. Hood Latch Mechanisms

Every 4 months or 6,000 miles, whichever occurs first, lubricate hood latch assembly and hood hinges as follows:

Wipe off any accumulation of dirt or contamination on latch parts and apply lubricant to latch striker and latch locking plate. Apply light engine oil to pivot points in release mechanism, as well as primary and secondary latch mechanism.

b. Hood Hinges

Lubricate hood hinges. Make hood hinge and latch mechanism functional check to assure the assembly is working correctly.

c. Gasoline Tank Filler Door Hinges

Apply a light coat of zinc oxide grease to all moving joints of the gasoline tank filler door hinges each spring and fall.

15. Points Requiring No Lubrication

No lubrication is required at the generator; water pump; propeller shaft bearings; driven wheel bearings; upper and lower rear control links; rear springs, shackles, or spring liners on Seventy-Five and Commercial chassis; starter motor, speedometer cable, as all of these bearings are packed with sufficient lubricant at time of assembly.

Although periodic lubrication is not required, replace damaged seals and add special lubricant, if required at the following locations:

a. Front upper and lower suspension arm pivot points.

b. Pitman arm or idler arm pivots.

c. Tie rod linkage.

16. Vibration Complaints and Correction

There are several excitation sources and many responding systems which may cause an annoying vibration. The first step is to identify individual vibration complaints by systematically classifying them, during a road test, into one or more of the following categories: (1) car speed sensitive, (2) engine speed sensitive, (3) torque (throttle) sensitive, or (4) jounce sensitive. Since each of these categories has specific vibrations associated with it, this classification will give direction to the proper area for analysis of the problem. This will eliminate many components that cannot be the cause, and will focus attention on only those items that can contribute to the specific condition encountered.

1. Road Test

Prior to the initial road test, check and adjust the tire pressures and install an engine tachometer. Next, ride the car with the owner driving and have him point out the disturbance with which he is concerned.

(NOTE: The importance of riding the car with the owner cannot be over-emphasized. Before a vibration can be corrected, you must know what disturbance the owner is objecting to and under what conditions it occurs.)

If the condition is normal, and no corrective work is needed, the owner should be told immediately. This normalcy can be demonstrated with other vehicles, pointing out that similar vehicles have the same condition.

2. Sensitivity Classification

Having verified that a vibration problem does exist, the first step in correcting the problem is to classify it in terms of one or more of the following sensitivity categories.

a. Car Speed Sensitive

Most vibration complaints will be found to be car speed sensitive, i.e., the frequency of the excitation depends only on the speed of the vehicle. To determine if a given problem is car speed sensitive:

(1) Drive the car in "Drive Left" and record the car speed and the engine RPM at which the problem occurs.

(2) Shift the car into "Drive Right" and again record the car speed and the engine RPM at which the problem occurs.

(3) If the problem occurs at the same car speed as when the car was in "Drive Left", the vibration is car speed sensitive.

(NOTE: It is possible that two problems could occur at the same car speed. Decelerate the engine to the RPM obtained in step 1 and check to see that problem has disappeared, if it has not, there are two problems, one of which occurs at the car speed determined in step 1, while the second occurs at the engine speed determined in step 1.)

b. Engine Speed Sensitive

Another group of vibration complaints will be found to be engine speed sensitive, i.e., the frequency of the excitation depends only on the speed of the engine, independent of the speed of the vehicle. Hence, to determine if a given problem is engine speed sensitive:

(1) Drive the car in "Drive Left" and locate the vibration problem. Record the car speed and the engine RPM at which the problem occurs.

(2) Shift the car into "Drive Right" and again locate the vibration problem. Record the car speed and the engine RPM at which the problem occurs.

(3) If the problem occurs at the same engine speed as when the car was in "Drive Left", the vibration is engine speed sensitive.

c. Torque Sensitive

A torque sensitive problem is one which increases in intensity as the torque (power) output of the engine increases, i.e., the intensity of the vibration increases as the throttle opening is increased. To determine if a given problem is torque sensitive:

(1) Drive the car in "Drive Left" and record the car speed and engine RPM at which the problem occurs.

(2) Observe the condition while varying the throttle position. Drive the car with steady throttle, slowly increasing to heavy throttle by going up hill or applying the brakes while increasing the throttle opening, and slowly decreasing to minimum throttle by coasting through the vibration speed.

(3) If the condition becomes more severe as the throttle opening is increased, the vibration is torque sensitive.

d. Jounce (or Load) Sensitive

A jounce (or load) sensitive problem is one which varies in intensity as the height of the car changes with respect to the surface of the road, i.e., the intensity varies as the rear springs are extended or compressed. To determine if a given problem is jounce (or load) sensitive:

(1) Drive the car and observe the condition with varying passenger load.

(2) Alternatively, drive the car over a road that dips in such a way that it causes the rear of the car to move up and down relative to the surface of the road. Keeping a constant throttle, observe the condition.

(3) If the condition varies depending on the passenger load (or varies as the rear of the car moves up and down), the problem is jounce (or load) sensitive.

e. Multiple Classification

In the process of classifying vibration problems in terms of these four sensitivity categories, you will find that many problems fit more than one of the categories. Combining these categories into their possible combinations, the majority of all vibration problems will fall into one of the following "classes" of categories:

(1) Engine speed sensitive only
(2) Car speed sensitive only
(3) Torque sensitive and car speed sensitive
(4) Torque sensitive and engine speed sensitive

3. Engine Speed Sensitive Only

Problems in this class may be duplicated with the car

stopped and the transmission in neutral by running the engine at the RPM at which the disturbance was felt during the road test. All additional appraisals can thus be made under this "free engine" condition.

"Free-engine" problems can be due to belts or engine driven accessories (power steering pump, generator, air conditioning compressor, fan, etc.). To isolate the offending component, first check the torque on all accessory mounting bracket bolts. Also, check the condition and tension of all accessory drive belts. If any abnormal conditions are found, correct and re-test for the vibration problem.

Air conditioning compressor problems can be diagnosed by turning compressor off and on while the vibration problem is being experienced.

If tightening the accessory mounting bolts and adjusting the drive belt tensions fails to correct the disturbance, remove accessory drive belts, one at a time, tighten the accessory mounting bolts, and re-test for the problem. Continue to remove the belts one at a time until the offending component is located.

CAUTION: With the water pump drive belt removed, the engine will overheat rapidly; hence, this appraisal must be made very quickly.

4. Car Speed Sensitive Only

All tire problems are sensitive to car speed only. Driveline unbalance or runout is sensitive to car speed at the rate of one vibration per revolution (First Order). Driveline vibrations at the rate of two or more vibrations per revolution, on either "C" cars or Eldorado, are sensitive to both car speed and torque, and should not be considered as "car speed sensitive only".

(NOTE: Vibration appraisal on the hoist should be performed on car speed sensitive problems only. Analysis of torque sensitive problems on stands will very often lead to erroneous conclusions, due to the fact that no appreciable torque is transmitted when the vehicle's tires are not touching the pavement.)

CAUTION: This procedure should never be attempted on the drive (front) wheels of an Eldorado. On these vehicles, evaluation must be done on the road.

a. Suspension Hop & Tramp (Tire Balance)

In order to verify Suspension Hop & Tramp as excited by tire balance and/or runout, proceed as follows:

(1) Install a complete set of known good wheel, tire and brake drum assemblies on the car and re-test on the road.

(NOTE: In all cases when removing the owner's wheels, tires, and brake drums, use care to index mark the brake drums to their respective wheel and tire assemblies so that they may be reinstalled in their original positions.)

If the problem disappears, then concentrate on the tire-and-wheel assemblies as being the cause of the problem, and hence proceed to Part B. If the problem still occurs in the same manner as before, inspect brake drums and/or rotors for unbalanced condition, since the tire-and-wheel assemblies are obviously not at fault.

(2) If known good tire, wheel, and drum assemblies are not available, place the car on a hoist or jack stand so that the rear of the car is supported by the axle, and remove the rear tire, wheel, and drum assemblies. Re-test the problem speed in the car under these conditions. If the disturbance is still present at the problem speed, tires are not the problem. If the disturbance cannot be duplicated on the hoist, then the tire, wheel, and drum assemblies were at fault and, hence, proceed to step 3.

CAUTION: This procedure should never be attempted on the driving (front) wheels of an Eldorado. It is therefore necessary to use the substitution method on these vehicles.

(3) Reinstall original tires in their original positions and balance all four tire, wheel and drum assemblies. Re-test on the road.

b. Balancing Wheels, Tires and Brake Drums

Many wheel balancers will adequately balance the wheel-tire-brake drum assembly; however, it is the skill of the operator that really counts. The operator must be well trained on the equipment used.

c. Checking Tire, Wheel, Brake Rotor and Rear Axle Runout

Excessive runout will cause a vibration which is exactly like unbalanced wheels and tires. After balancing tires, if a 1st order tire disturbance still exists, check runout as follows:

1. Wheel and Tire Runout

Follow procedure described in Section 10; Note 4d. If the runout cannot be reduced to acceptable values by repositioning the tire and wheel, replace the parts at fault. Re-test on the road.

2. Brake Rotor and Axle Shaft Runout

a. If after checking wheel runout (radial and lateral), it is determined that excessive runout is present, before replacing wheel, check brake rotor or axle shaft for runout with a dial indicator. Refer to Section 5 Note 15 for specifications on rotor runout. Axle flange runout should be less than .006 inch.

b. If lateral (in-out) wheel runout (wobble) is beyond specifications, check brake drum to wheel pads (front end) or axle flange (rear end) for lateral runout. The dial indicator stem should contact the axle flange or drum pads as close as possible to the outboard side of the studs.

d. Suspension Hop and Tramp (Other Than Tire Balance)

If the disturbance is still present, the problem is due to a non-uniformity in one or more of the tires. This fault is inherent in the tire and cannot be corrected by any means other than replacement. The problem which remains at this point, however, is to isolate the offending tire(s). This may be accomplished by replacing each tire-wheel-drum assembly with a known good assembly one

at a time and re-testing on the road until the offending assembly is located. (if known good "test tires" are not available, tires from a known good car with comparable tires may be used to isolate the defective tire.) When the offending tire is located, replace it, rebalance the entire assembly and drive the car for a final road appraisal.

5. Torque Sensitive and Car Speed Sensitive

The only excitation which is both car speed sensitive and torque sensitive is 2nd Order driveline (two vibrations per revolution) on the "C" car or 3rd Order Driveline (three vibrations per revolution) on the Eldorado. These problems are caused by improper drive shaft angles which are a result of wrong standing height or faulty joints. Refer to Section 3, Notes 1 or 18 to check standing height. Drive axle joint replacement is described in Section 3, Note 35 and 36.

6. Torque Sensitive and Engine Speed Sensitive

The only excitation which is both engine speed sensitive and torque sensitive is the "firing order" excitation (that is, 4th Order for an eight cylinder engine). The problems likely to be encountered in this class are as follows:

a. Powerplant "bending" as excited by 4th Order Engine.

b. Exhaust system "bending" as excited by 4th Order Engine. (This may include either the crossover pipe, exhaust pipe, or tailpipe).

c. An engine-driven accessory (power steering pump, generator, air conditioning compressor, etc.) excited by 4th Order Engine.

Engine driven accessories generally do not present a problem if all attachment bolts are torqued to specifications and all drive belts are adjusted to the proper tension. Hence, in order to verify that an engine-driven accessory is not the cause of a vibration complaint:

d. Check installation torques on all attachment bolts securing either an accessory to its mounting or the mounting to the engine.

e. Check all drive belts for correct tension. Also check the physical condition of the belts.

f. Visually inspect each accessory to ensure that the bracketing installed is complete and properly assembled.

g. The checks outlined above should be performed and any irregularities corrected before proceeding.

h. Powerplant "bending" as excited by 4th Order Engine.

(1) Loosen the top four bolts which attach the transmission to the engine, and reappraise the problem. If this is the actual cause of the complaint, the problem should now occur at a much lower engine speed than it did originally, or be completely eliminated. Retorque bolts before proceeding.

(2) Having thus verified that this is the actual cause of the complaint, the following procedures are suggested as a means of correction:

(3) Inspect the vehicle to be sure the entire engine-transmission assembly and the exhaust system are not in contact with the frame or body.

(4) Inspect the engine and transmission mounts to be sure they have not sagged, failed, or been distorted.

(5) Check the initial spark advance setting.

(6) If these inspection procedures reveal any irregularities, correct and re-test on the road.

i. Exhaust System

CAUTION: It is often convenient to test for exhaust system vibrations by stalling the engine in Drive with the brakes applied. However, a car should never be stalled at engine speeds greater than 1200-1300 RPM and never for extended periods of time, since the transmission may overheat. When this method of testing is used, it is best done on a hoist, permitting the driveline and rear axle to rotate after each appraisal to circulate transmission oil. Do not use this test method for any problem occuring above 1300 RPM.

When a particular component of the exhaust system, such as the exhaust pipe or tailpipe, is suspected of causing a vibration problem, it may be verified by the following procedure:

(1) Put the car on a hoist with a helper behind the wheel and all doors and windows closed. Next, stall the vehicle in "Drive" as described above in the problem RPM range, while pressing a metal object (such as a wrench or screwdriver) lightly against the suspected component. If this component is the cause, it will "buzz" or "rattle" against the wrench or screwdriver due to its vibratory motion.

(2) To further verify that the suspected component is the cause, pull down rather heavily on that component while the driver evaluates the problem RPM range for any reduction in the level of the disturbance. This method of verification may also be applied on a road test by clamping a 5-10 lb. metal weight securely to the suspected component. Such a weight will change the resonant frequency of the component in question, and hence will change the problem speed if it is actually the cause.

(3) To verify disturbances produced by exhaust system components which resonate beyond 1300 RPM (such as the exhaust crossover), the stall technique cannot be used. In these cases, it is best to use the weight-and-clamp method together with a road test.

Having verified that some component of the exhaust system is the cause of the problem, the following procedures should be used to correct the disturbance.

(4) Since the majority of exhaust system problems are due to "bound up" conditions, loosen all joints in the entire system, and let the pipes rest on floor stands while each clamp and bolt is torqued to specification. Refer to Section 8.

(5) Visually inspect the entire system for sufficient clearance of all points, (at least 1/2" in all directions) especially those in the direction of engine roll under acceleration.

(6) Visually inspect all exhaust system hangers to ensure that there is no metal-to-metal contact.

(7) Ensure that the end of the tailpipe is not directed at the inside surface of the rear bumper, but below it.

(8) After these procedures have been performed and any irregularities corrected, re-test on the road.

PREVENTIVE MAINTENANCE

17. Periodic Preventive Maintenance Operations

a. Cooling System

Flush every 24 months or 24,000 miles, whichever occurs first, with clear water and add ethylene glycol base coolant. Refer to Section 6, Note 6, for information on the preparation of the cooling system for cold weather.

Replace radiator and heater hoses every two years or 24,000 miles, whichever occurs first.

(NOTE: Supplemental inhibitors or additives claiming to provide increased cooling capability that have not been specifically approved by GM are not recommended for addition to the cooling system. These additives may be detrimental to the efficient operation of the system, and they represent an unnecessary operating expense.)

b. Fuel Filter

Replace fuel filter every 12 months or 12,000 miles.

c. Engine Oil Filter

Replace filter at time of first oil change and every other oil change thereafter.

d. Air Conditioner

Each spring and fall:

1. Clean out insects and dirt from condenser.
2. Check compressor belt tension, Section 6, Note 10.
3. Check overall performance of air conditioner.
4. Check sight glass for full charge of refrigerant.
5. Leak test system for refrigerant and oil leaks.

For complete air conditioner maintenance, see Section 1, Note 44.

MAINTENANCE SERVICE AND SCHEDULE

A program of preventive maintenance is an essential part of vehicle operation. The proper care and maintenance of a new Cadillac as set forth in the Cadillac Owner's Manual will preserve an owner's investment, avoid expensive repairs and will ultimately result in lasting satisfaction for the Cadillac owner. When new Cadillac cars are brought in for service, the suggested inspections and maintenance services as listed below should be performed by the serviceman. These inspection and maintenance services are those which experience and testing have shown to be the most likely needed services at that particular mileage or time interval for an average owner. However, driving habits, driving conditions, geographical locations and climatic conditions all influence maintenance requirements.

In addition to these maintenance services, some components of the vehicle may require periodic maintenance depending upon usage.

The Cadillac serviceman should also recommend additional items of maintenance based on conditions such as local weather, owner driving habits, and factory service bulletins.

The maintenance schedule outlined on pages 0-17 through 0-19 will provide the serviceman with an excellent reference for seasonal maintenance recommendations as well as regular inspections and maintenance services.

MAINTENANCE SCHEDULE

INTERVAL	SERVICE TO BE PERFORMED
Every 4 months, never to exceed 6,000 miles	Change engine oil. Oil change may be required every 2 months or 3,000 miles if car is driven under severe operating conditions. Clean crankcase ventilating breather on left rocker arm cover. Inspect front and rear suspension and steering linkage. Replace damaged seals and add special lubricant if required. Check power steering lines and hoses for leaks, deterioration and chafing. Check tires for damage, wear and proper inflation. Check condition of wheels. Check underside of car for excess dirt (mud, gravel, tar, etc.) paying particular attention to propeller shaft, wheels, brake drums and disc brake components. Set idle speed, ignition timing, and dwell. Check brake fluid level. Check brake lines for leaks. Inspect brake hoses for cracking, abrasions, cuts or tears in the outer covering. Check brake pedals (parking and service) for travel. Check battery electroylyte level. Check transmission fluid level.

MAINTENANCE SCHEDULE (Cont'd)

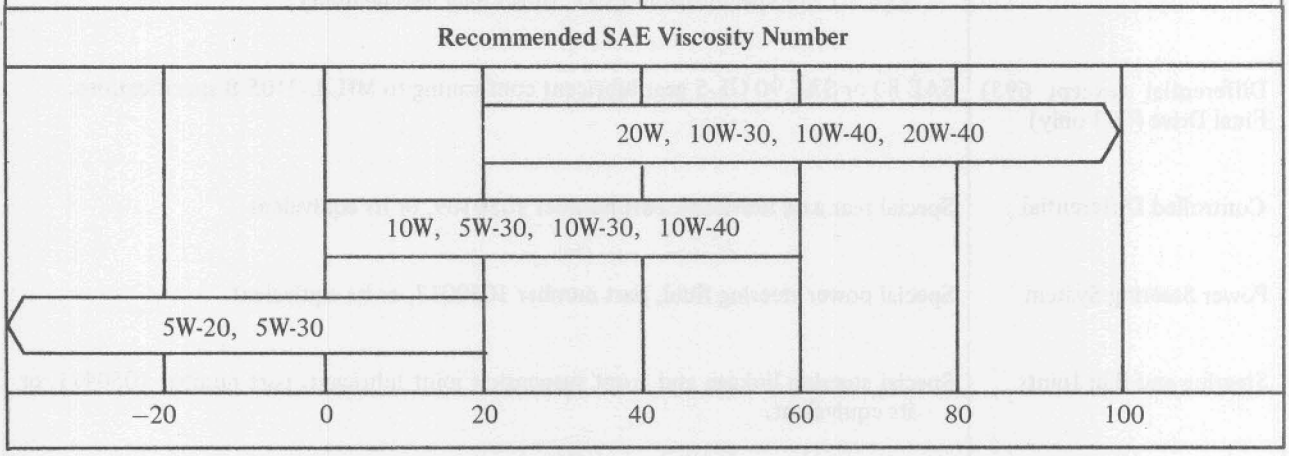
INTERVAL	SERVICE TO BE PERFORMED
Every 4 months, never to exceed 6,000 miles (Cont'd.)	Check power steering fluid level. Check coolant level in overflow reservoir. Check for fuel, water and oil leaks. Check items affecting vehicle emission control and related parts at first oil change. Inspect complete exhaust system for broken or damaged parts, deterioration, broken seams or loose connections which may cause leaks. Replace or adjust as required. Whenever a new muffler is installed, all pipes and resonators rearward of that muffler should be replaced. Wipe off any accumulation of dirt or contamination on hood latch parts and apply lithium grease to latch pilot bolts and latch locking plate. Apply light engine oil to all pivot points in release mechanism, as well as primary and secondary latch mechanisms. Check operation of hood latches. Apply a few drops of light oil to all moving joints of the hood hinges. Apply lithium grease to hood bumpers, front and rear. Check all engine drive belts. Adjust if necessary, at first oil change. Check choke for free operation. Check operation of thermac air cleaner. Clean radiator core exterior. Torque carburetor to intake manifold bolts at first oil change.
Every 6 months	Check coolant level and maintain freeze protection.
At first oil change and every second oil change thereafter	Change engine oil filter.
Every 6,000 miles	Rotate tires. Tire rotation may be required more frequently on Eldorado (4,000 miles) if car is driven under extreme operating conditions. Replace spark plugs (if leaded fuels are used). Check brake linings for wear at first 6,000 miles.
Every 12 months or 12,000 miles	Check brake linings for wear. Inspect parking brake cables for wear and binding. Lubricate cables every 6 months after the first inspection. Clean, inspect or replace, if necessary, crankcase ventilation system hose, fittings and attaching parts. Check speed controlled spark system for proper operation. Check thermal vacuum switch for proper operation. Inspect spark plug wires (beginning at 24 months or 24,000 miles). Replace spark plugs (if unleaded fuels are used). Inspect distributor points. Rotate distributor cam lubricator 1/2 turn. Apply cam lubricant. Change fuel filter. Inspect carburetor air cleaner elements. Replace if necessary. Tighten rocker arm cover screws. Check headlight aim. Check throttle linkage for damaged or missing parts, interference or binding. Check operation of washer fluid monitor. Torque body bolts to specification.
Every 24,000 miles	Drain transmission pan and add fresh DEXRON® type Automatic Transmission Fluid or fluid of equivalent quality. Fluid change may be required at 12,000 miles if car is driven under severe operating conditions. Replace transmission filter after the first 24,000 miles, or in any case of major transmission failure.
Every 24 months or 24,000 miles	Replace carburetor air cleaner element. More frequent replacement may be necessary if vehicle is driven in dusty areas.

MAINTENANCE SCHEDULE (Cont'd)

INTERVAL	SERVICE TO BE PERFORMED
Every 24 months or 24,000 miles (Cont'd.)	Clean and oil clock. Replace positive crankcase ventilation valve. Replace radiator and heater hoses. Flush cooling system and refill with ethylene glycol base coolant solution. Replace distributor points and cam lubricator. Clean distributor cap and wires. Inspect AIR system hoses and connections. Check all engine drive belts. Adjust as necessary. Replace filter in carbon canister and inspect canister. Inspect evaporative loss control system for leaks. Inspect fuel tank, cap and lines for leaks. Check engine compression.
As required	Wheel alignment and balance.
Every spring and fall	Lubricate accelerator linkage. Check transmission for leaks and lubricate linkage. Check and open muffler and resonator drain holes. Check rear axle assembly for leaks (all except Eldorado). Check final drive assembly for leaks (Eldorado only). Inspect and open body and door drain holes. Test cooling system for leaks and coolant for freeze protection. Leak test and check complete operation of air conditioning system. Check lap belts, shoulder belts, buckles, retractors and anchors for loose connections and damage. Check operation of windshield wipers and washers. Replace wiper blades if necessary. Check operation of seat back latches. Check rear view mirrors and sun visors to make certain that friction joints are properly adjusted. Adjust mirror so that it does not interfere with right hand sun visor when it is lowered. Check choke operation. Clean battery terminals and clamps. Check operation of defroster. Lubricate door hinges, etc. Check operation of all door latches. Lubricate fuel filler door. Check engine for oil leaks. Check condition of radiator and heater hoses and replace as necessary. Check operation of engine and water temperature warning lights. Check all exterior and interior lighting.

ENGINE OIL CHANGE INTERVAL AND VISCOSITY CHART

ENGINE OIL RECOMMENDATION	OIL VISCOSITY PRECAUTIONS
Use only high quality oils intended for service "SE". The chart below will serve as a guide for selecting proper oil viscosity. Change oil every 4 months never to exceed 6,000 miles. Change oil each 2 months or 3,000 miles, whichever occurs first, under the following conditions: Driving in dusty areas, trailer towing, extensive idling, short trip operation (engine not thoroughly warmed up).	SAE 5W-20 oils are not recommended for sustained high-speed driving. SAE 30 oils may be used at temperatures above 40°F.



Temperature range anticipated before next oil change, °F.

FLUID CAPACITIES

All Series Unless Otherwise Noted	U.S. Measure	Imperial Measure
Engine Crankcase		
All (Except Eldorado)	4 Quarts	3-1/4 Quarts
Eldorado Only	5 Quarts	4-1/4 Quarts
When Filter is Changed		
All (Except Eldorado)	5 Quarts	4-1/4 Quarts
Eldorado Only	6 Quarts	5 Quarts
Cooling System		
With Air Conditioning*	21.8 Quarts	18-1/4 Quarts
With Heater Only*	21.3 Quarts	18 Quarts
75 Series Only	24.8 Quarts	20-3/4 Quarts
Air Conditioner - Refrigerant 12	4 Pounds	4 Pounds
75 Series Only	5-1/4 Pounds	5-1/4 Pounds
Air Conditioner Compressor Oil -		
525 Viscosity	10-1/2 Fluid Ounces	8-3/4 Ounces
75 Series Only	13-1/2 Fluid Ounces	11-1/4 Ounces
Rear Axle (Except Eldorado)	5 Pints	4-1/2 Pints
Final Drive (Eldorado only)	4 Pints	3-1/3 Pints
Gasoline Tank (All Series)	27.5 Gallons (Approx)	23 Gallons (Approx.)
Turbo-Hydra-matic Transmission		
(Except 693)		
Dry	12 Quarts, 1 Pint	10 Quarts
Pan and Filter Removed	8 Pints, 3 Ounces	6 3/4 Pints
(Eldorado only)		
Dry	13 Quarts, 1 Pint	10-3/4 Quarts
Pan and Filter Removed	11 Pints, 9 Ounces	9-1/2 Pints

*Capacity is increased 2 quarts (1-1/2 Imperial quarts) on cars with trailer towing package or H.D. cooling.

FACTORY RECOMMENDED FLUIDS

Unit	Fluid Recommendations
Engine Oil	Oils which, according to the label, are intended for service, "SE".
Transmission	"DEXRON" ® type Automatic Transmission Fluid, part number 1050568, or other equivalent quality fluids.
Brake System	Super Heavy duty Brake Fluid, part number 5464831, or brake fluids conforming to SAE J-1703 Specifications (SAE 70-R3 may also be used).
Differential (except 693) Final Drive (693 only)	SAE 80 or SAE 90 GL-5 gear lubricant conforming to MIL-L-2105-B specifications.
Controlled Differential	Special rear axle lubricant, part number 1050189, or its equivalent.
Power Steering System	Special power steering fluid, part number 1050017, or its equivalent.
Steering and Ball Joints	Special steering linkage and front suspension joint lubricant, part number 1050411, or its equivalent.
Propeller Shaft Front Slip Yoke (Fleetwood Seventy-Five Sedans and Limousines and Commercial Chassis)	Transmission fluid.
Propeller Shaft Slip Yoke (681, 682, 683)	Outside diameter with transmission fluid. Inside diameter with synthetic oil seal lubricant, part number 1050169, or its equivalent.
Battery	Colorless, odorless, drinking water.
Radiator	Ethylene glycol base, anti-freeze coolant (50-50 mixture with water).
Engine Fuel	"No-Lead", "Low-Lead" or regular grade gasoline having a research octane number of 91 or higher.
Air Conditioning System Lubricant	525 viscosity refrigeration oil.
Refrigerant	Refrigerant "12".

1

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DIAGNOSIS OF PROBLEMS—FRONT A/C—ALL SERIES

1. How to Isolate the Problem

During diagnosis it is important to remember that the 1972 air conditioning and heating system is essentially the same as the 1971 system. However, both the 1971 and 1972 systems are functionally different than earlier models in the following manner:

1. Low blower continues to operate in heater mode when in the "OFF" position at all times except when both the engine and the car's interior are cold.
2. The "BI-LEVEL" lever setting provides both upper and lower level air simultaneously, otherwise, it operates the same as the "AUTO" position with changes in discharge temperatures and blower speeds. It has the same function as the "FOG" setting in the 1971 model.
3. The "DEF" lever setting is the same as the 1971 "ICE" position providing fixed high blower air from the defroster outlets and a bleed out the heater outlet. Otherwise, it operates similar to "HI," in that the air temperature varies depending on the position of the programmer and blower speed remains at fixed high.

To diagnose an air conditioner problem in the

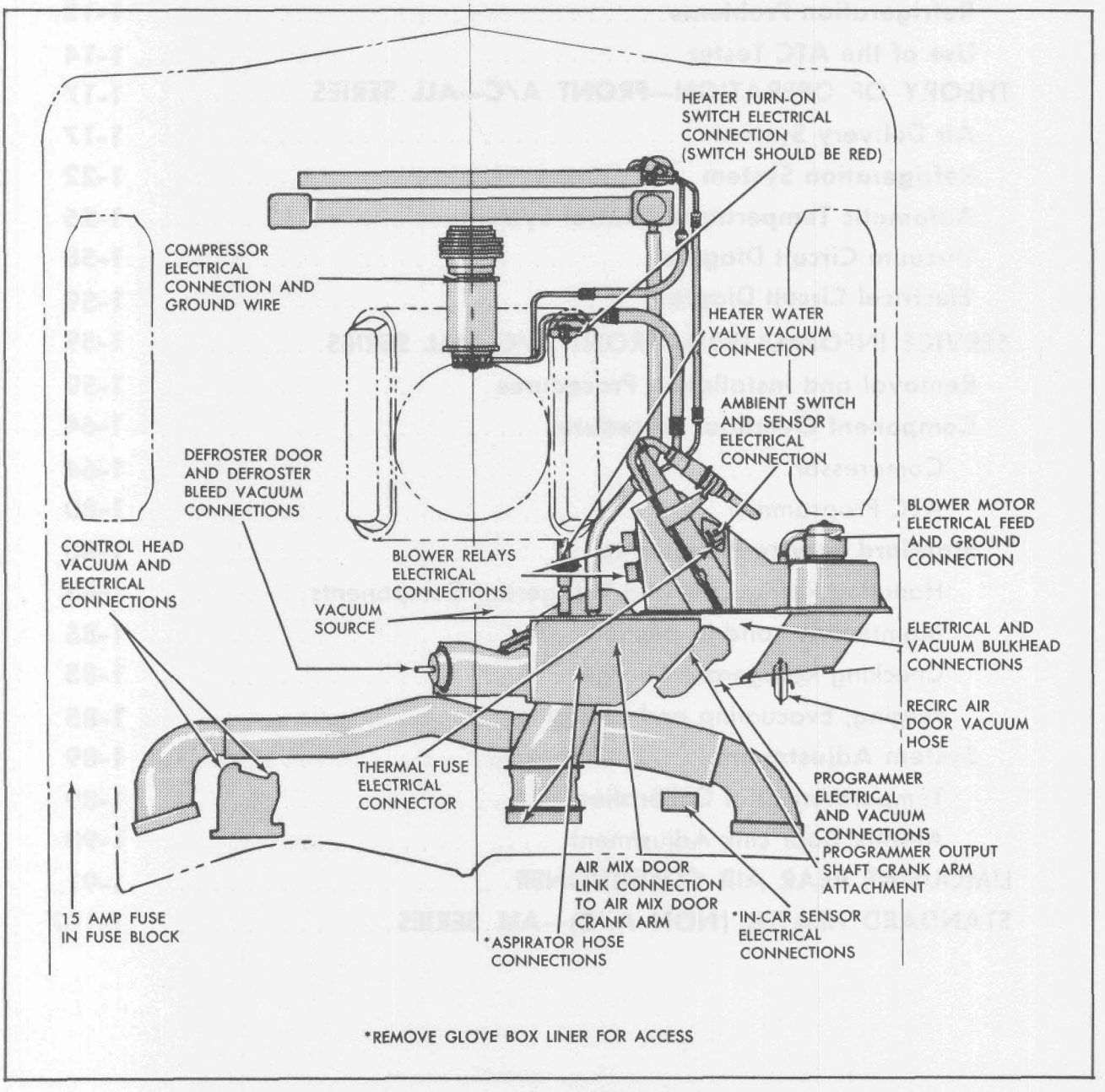


Fig. 1-1 A/C Diagnosis Areas

shortest time and with the least effort, it is essential to follow a logical service procedure. Time spent in conducting a system functional performance test and analyzing the defect in order to isolate it to a specific control function area will be repaid in reduced repair time. A recommended diagnosis procedure follows:

STEP 1 - Attempt to get an accurate, detailed description of the owner's complaint in writing on the repair order. "A/C inop." or "erratic operation" do not provide much information to the repairman.

STEP 2 - To confirm the system defect make a brief check of system operation by sitting in the car and operating the controls, with the engine warmed up and running at 1000 RPM or higher, in the following sequence:

AUTOMATIC TEMPERATURE CONTROL FUNCTIONAL TEST	
CONTROL SETTING	SYSTEM SHOULD OPERATE AS FOLLOWS:
"DEF" DIAL @ 85	Air should be delivered out of defroster outlets at a fixed high blower speed. Some floor bleed out heater.
"BI-LEVEL" DIAL @ 75°	Air should be delivered from both the A/C and heater outlets at a reduced blower speed. Only a small portion of air will come out the defroster outlet.
"HI" DIAL @ 65°	Air should be delivered out the A/C outlets at a fixed high blower speed and cool to cold temperature. The recirculating air door should open (blower noise increases). Door movement will be slow because of vacuum delay plug.
"AUTO" DIAL @ 65°	After 45 seconds the A/C discharge air should drop to 50°F or lower (may be slightly higher in 90°F or above ambients). Recirc air door should close (noise level will drop).
"AUTO" DIAL @ 85°	Blower speeds should drop (Hi - M_3 - M_2 - M_1 - etc.) and discharge air temperature should increase. Depending on the temperature in the work area, the air delivery mode should change from the A/C outlets to the heater outlets.
"LO" DIAL @ 85°	Air should be delivered at a fixed low blower speed.
"VENT" DIAL @ 85°	Air should be discharged from the A/C outlets at a fixed low blower speed. The A/C compressor should not operate.
"OFF" DIAL @ 65°	Air should be discharged out the heater outlet at a fixed low blower speed. No A/C compressor operation.

During the above tests, be sure to note the following:

a. Check to assure that air delivery is not coming from both the A/C and heater outlets when only one mode is indicated. A split air delivery is indicative of a vacuum leak.

b. Note whether program events (air delivery mode change, blower speed change, recirc air, etc.) occur without change in discharge air temperature. This would indicate the programmer is operating without moving the temperature air door. Check the air mix door link to programmer connection.

c. If neither the program events nor the discharge air temperature change, a faulty vacuum or electrical signal to the programmer or a programmer malfunction is indicated.

d. Failure of a specific vacuum operated door function could indicate a vacuum disconnect of the vacuum diaphragm at that door. See illustrations for locations of the different function doors.

STEP 3 - Perform the easiest checks first! A simple, visual inspection of the easily accessible underhood and instrument panel electrical and vacuum connections will, in many instances, reveal the defect on the spot. The areas indicated in Fig. 1-1 can be inspected without removing any car parts:

STEP 4 - Based on information gained during the functional test performed in step 2, try to relate the problem to one of the following areas:

1. Temperature Control Problems
2. Blower Control Problems
3. Auxiliary Vacuum Problems
4. Refrigeration System Problems

Once a problem has been isolated to one of the areas listed above, refer to that diagnosis section on the following pages. Diagnosis charts and Control Circuit illustrations are provided. It is of special importance to be familiar with the general description of the major sections of the system as presented in the Theory of Operation section beginning on page 1-16.

STEP 5 - After the problem has been properly diagnosed and the repair made, it is important to run through the brief check listed in Step 2 in order to assure that the system is now performing correctly.

2. Temperature Control Problem Diagnosis

The temperature control circuit consists of the components shown in Fig. 1-2. The primary function of the temperature control circuit is to determine the correct temperature of the air to be discharged into the passenger compartment and to set the air mix door position to accomplish that function. The signal used for this purpose (vacuum to position the programmer vacuum motor) is also used in the blower speed control circuit. and the auxiliary vacuum function circuit. Those uses may be disregarded when dealing with problems which relate only to the temperature control circuit.

Examples of temperature control problems are: "System operates at maximum air conditioning (no heat) or only at maximum heating (no air conditioning)", "Temperature dial does not provide comfort", "Poor heating or poor cooling". Blower cycling and mode cycling are also caused by a malfunction in the

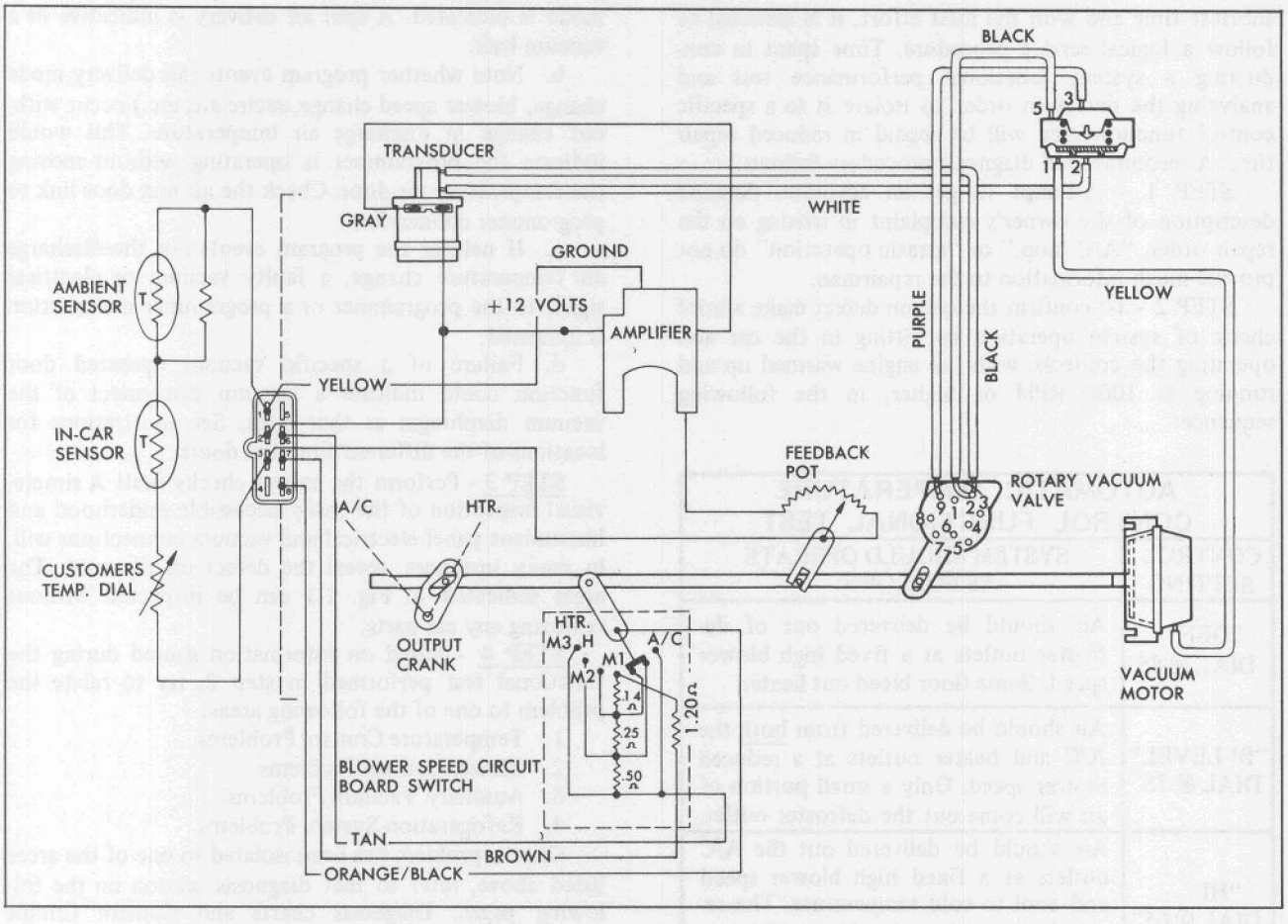


Fig. 1-2 Temperature Control Circuit

temperature control circuit. For a brief, detailed explanation of how the temperature control circuit operates, refer to the operation section on page 1-24.

It is important to separate temperature control circuit problems from refrigeration or heater circuit problems. If the complaint is "poor" or "no" heating or cooling and the programmer moves to both extremes of travel with the air mix door and program functions known to follow, the problem probably lies in the refrigerant or heater water circuits. Refer to that section on page 1-21.

Many temperature control problems result from poor electrical or vacuum line connections. The following relationships may aid diagnosis:

- A disconnected sensor or temperature dial interrupts the electrical signal and drives the programmer to maximum heating.
- A poor sensor connection adds resistance to the sensor string driving the system hotter.
- An open amplifier power feed eliminates the output signal and drives the programmer to maximum heating.
- A disconnected transducer lead drives the programmer to maximum heating.
- A disconnected vacuum hose supplying the vacuum checking relay actuating nipple will lock the relay in an intermediate position.
- A disconnected vacuum hose in the transducer - programmer vacuum motor line will drive the system to maximum cooling.
- A leak in the auxiliary vacuum circuit may reduce the transducer vacuum supply level below control requirements, causing an "off-calibration" or "poor heating" type of complaint.
- A loss of supply vacuum usually results in cold air flow on the floor.

Diagnosis of most of the problems encountered in the temperature control circuit will be greatly aided by use of tester, J-23678. Information on how to use the A.T.C. Tester appears at the end of this section. (Instructions also accompany the tester.)

Specific problems and probable causes are as follows:

SYSTEM OPERATES ONLY AT MAXIMUM AIR CONDITIONING

This can be a vacuum or electrical problem. The problem can be separated into problems of erroneous signal external to the programmer or internal programmer malfunctions. With the system operating, disconnect the programmer electrical connector, and observe the programmer movement through the slot at the bottom of the programmer cover. If the programmer remains in the maximum air conditioner position, remove the multiple vacuum connector and check for supply vacuum at the black hose. If no (or low) vacuum supply, check for leaks or disconnects in vacuum hose assembly. If vacuum supply is okay, programmer is malfunctioning. Remove programmer cover and inspect for obvious disconnects. If no programmer defect is obvious, use tester J-23678 to analyze and correct problem.

If the programmer moved to the maximum heater position when the electrical connector was removed, the defect is external to the programmer. Check the following items:

1. Shorted in-car sensor or ambient sensor.
2. Shorted or miscalibrated temperature dial.
3. A short in the sensor circuit of the wiring harness.

SYSTEM OPERATES ONLY AT MAXIMUM HEATING

This is usually an electrical problem. Problems outside of the programmer can generally be separated from internal programmer malfunctions. To do this, set the temperature dial to 65° and the control lever to the "Vent" position with the system operating. Observe the programmer through the slot located in the lower half of the programmer cover to see if the programmer now moves to the maximum air conditioning position. If the programmer does move, the problem is one of the following areas:

1. Disconnected or defective in-car sensor.
2. Disconnected or defective ambient sensor.
3. Open circuit or backed-out terminal in the wiring harness sensor string circuit.
4. Disconnected or back-out terminal in the 3-way connector located under the instrument panel on the R.H. side of car near the programmer.

If the programmer did not move when the control was put to "Vent", the problem lies in one of the following areas:

1. Disconnected or defective temperature dial.
2. Disconnect or open in ground circuit (black wire) between control head and programmer.
3. No electrical power to programmer (yellow wire).
4. No ground at amplifier.
5. Defect within programmer assembly.

Use Tester, J-23678, to analyze and correct the above problems.

SYSTEM FLUCTUATES BLOWER SPEEDS and/or MODE SHIFTS DURING ACCELERATION

1. Defective vacuum checking relay (inside programmer).
2. Leaking programmer vacuum motor.

It is possible to distinguish between the two above items. With the system operating and the programmer cover removed, reinstall the vacuum and electrical connectors, and perform the following steps:

a. Remove the programmer electrical connector to force the programmer to maximum heating (full vacuum).

b. Remove the vacuum hose assembly connector. The programmer should remain in the maximum heat position. If it does not, repeat Step a, and then pinch the programmer vacuum motor supply hose with a pair of needle-nose pliers. If the programmer still moves, the vacuum motor is leaking. If the programmer does not move, the checking relay is defective.

c. If the original complaint was mode shifts without blower change, the check valve portion of the checking relay is probably defective.

DIAL SETTING DOES NOT PROVIDE COMFORT

The best approach to solving problems of the "off calibration" variety, is to use Tester, J-23678, to check and reset calibration on all of the following parts:

1. The temperature dial.
2. The feedback potentiometer in the programmer.
3. The temperature door link adjustment.
4. The sensor string.

(NOTE: Check to assure that in-car sensor aspirator hose is attached at both the in-car sensor and the aspirator and not kinked in routing.)

Refer to the instruction sheet included with the Tester or the section on System Adjustments for procedures on checking and calibrating the above items (Page 1-88).

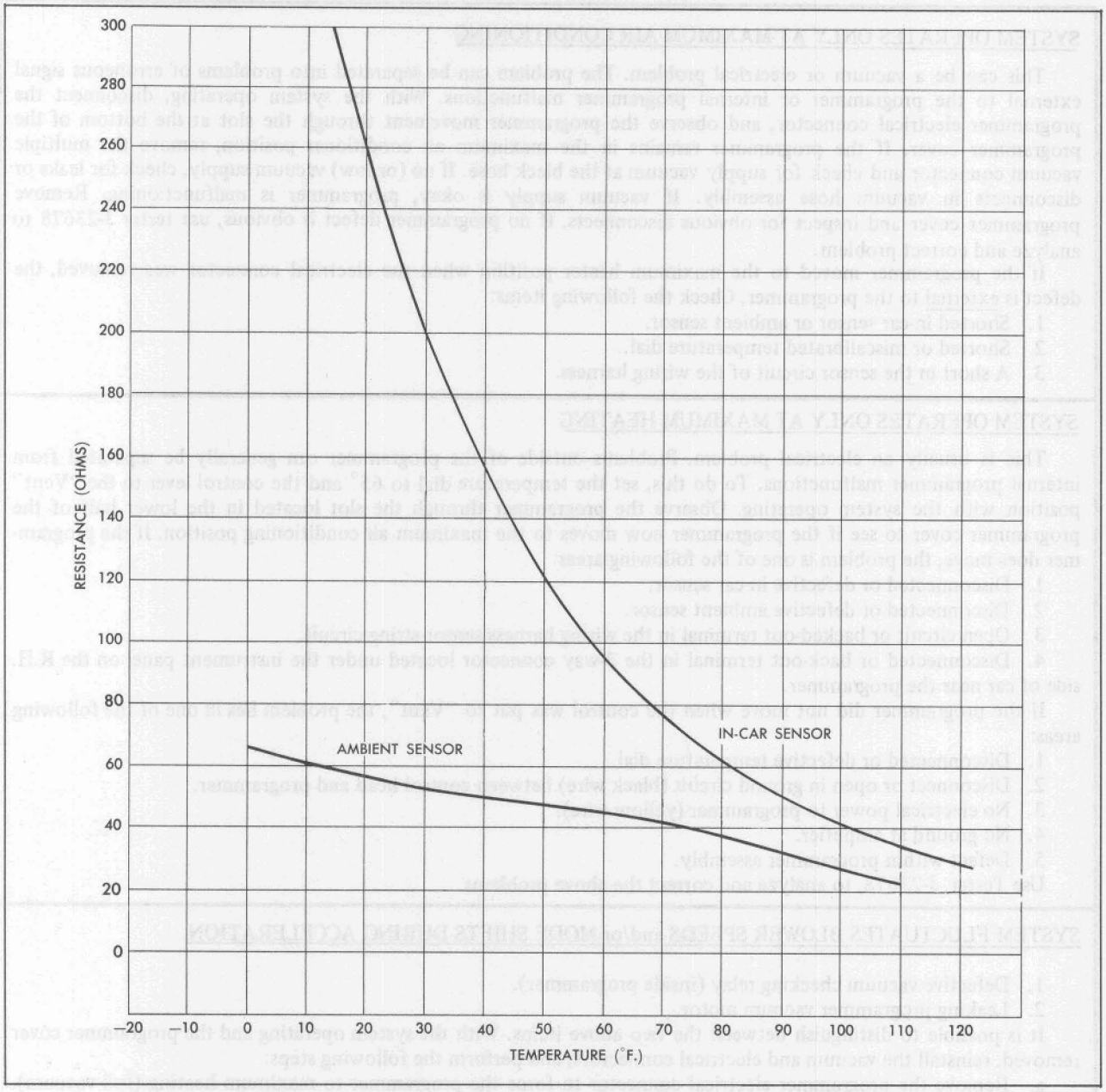


Fig. 1-3 Resistance Graph of Sensors

BLOWER CYCLING AND MODE CYCLING

Erratic system performance may be caused by poor electrical connections, "cold" solder joints, or a defective sensor or amplifier. The problem may be intermittent and occur from the shock of going over road bumps. Such a problem may be accompanied by a clicking or buzzing of the transducer. To isolate the problem area, "rap" the areas around the sensors, control head, and programmer, and shake the wires attached to those areas. Listen for buzzing or clicking of the transducer. If the problem cannot be pinpointed by transducer buzzing, remove the programmer cover, (reinstall the vacuum and electrical connectors) and attach a good voltmeter to the transducer output terminal (grey wire). Repeat the rapping and wire shaking, and observe the voltmeter for violent, erratic voltage fluctuations. Replacement of parts or resoldering of terminals may be necessary. The sensors may be individually checked to the sensor resistance curve, Fig. 1-3.

(NOTE: Some system cycling may also occur and is normal if the temperature dial is moved in large increments. Instruct owner of this, and explain system operation.)

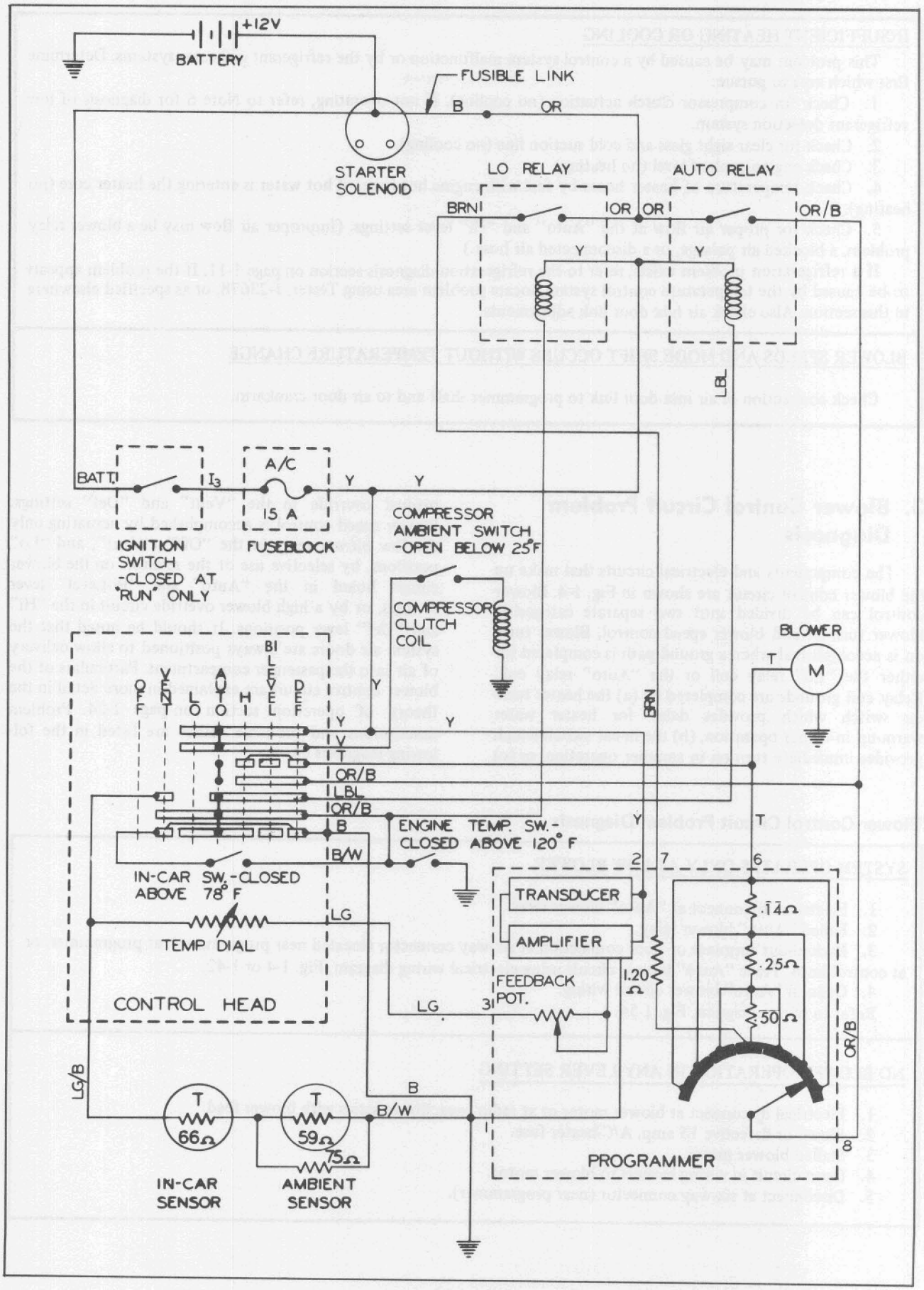


Fig. 1-4 Blower Control Circuit

INSUFFICIENT HEATING OR COOLING

This problem may be caused by a control system malfunction or by the refrigerant or heater systems. Determine first which area to pursue:

1. Check for compressor clutch actuation (no cooling). If not operating, refer to Note 6 for diagnosis of low refrigerant detection system.
2. Check for clear sight glass and cold suction line (no cooling).
3. Check engine coolant level (no heating).
4. Check temperature of heater hoses by feel with engine hot to see if hot water is entering the heater core (no heating).
5. Check for proper air flow at the "Auto" and "Hi" lever settings. (Improper air flow may be a blower relay problem, a blocked air passage, or a disconnected air hose.)

If a refrigeration problem exists, refer to the refrigeration diagnosis section on page 1-11. If the problem appears to be caused by the temperature control system, locate problem area using Tester, J-23678, or as specified elsewhere in this section. Also check air mix door link adjustments.

BLOWER SPEEDS AND MODE SHIFT OCCURS WITHOUT TEMPERATURE CHANGE

Check connection of air mix door link to programmer shaft and to air door crankarm.

3. Blower Control Circuit Problem Diagnosis

The components and electrical circuits that make up the blower control circuit are shown in Fig. 1-4. Blower control can be divided into two separate categories, blower turn-on and blower speed control. Blower turn-on is accomplished when a ground path is completed for either the "Lo" relay coil or the "Auto" relay coil. Relay coil grounds are completed by (a) the heater turn-on switch which provides delay for heater water warm-up in winter operation, (b) the in-car switch which provides immediate turn-on in summer operation, or (c) manual override in the "Vent" and "Def" settings. Blower speed control is accomplished by actuating only the low blower relay in the "Off", "Vent", and "Lo" positions, by selective use of the resistors on the blower circuit board in the "Auto" and "Bi-Level" lever settings, or by a high blower override circuit in the "Hi" and "Def" lever positions. It should be noted that the system air doors are always positioned to allow delivery of air into the passenger compartment. Particulars of the blower control circuit are explained in more detail in the theory of operation section on page 1-24. Problem descriptions and probable causes are listed in the following diagnosis chart:

Blower Control Circuit Problem Diagnosis

SYSTEM OPERATES ONLY AT LOW BLOWER

1. Electrical disconnect at "Auto" blower relay.
2. Failed "Auto" blower relay.
3. Backed-out terminal or poor connection at six-way connector (located near programmer), at programmer, or at control head. Trace "Auto" blower circuit using electrical wiring diagram, Fig. 1-4 or 1-42.
4. Open in "Auto" blower circuit wiring.

Refer to wiring diagram, Fig. 1-54.

NO BLOWER OPERATION IN ANY LEVER SETTING

1. Electrical disconnect at blower motor or at radio capacitor in series with blower feed.
2. Blown or defective 15 amp. A/C-heater fuse.
3. Stalled blower motor.
4. Open circuit in wiring harness to blower motor.
5. Disconnect at six-way connector (near programmer).

NO BLOWER IN OFF, VENT OR LO SETTINGS

1. Disconnect at "Low" blower relay.
2. Failed "Lo" blower relay.
3. Open low speed resistor on programmer.
4. Backed-out terminal or poor connection at six-way connector (located near programmer) or at programmer.

Trace low blower circuit using electrical wiring diagram, Fig. 1-41.

5. Open in low blower circuit wiring. Rever to wiring diagram, Fig. 1-54.

OPERATES AT LOW BLOWER ONLY EXCEPT IN "HI" AND "DEF"

1. Defect in programmer wiper contacts or board.
2. Backed-out terminal or misconnect at programmer electrical connector.
3. Open in programmer internal wiring.

BLOWER OPERATION ONLY IN "HI" OR "DEF"

1. Electrical disconnect at programmer (system will also operate only at maximum heat).

BLOWER SPEED VARIES IN "HI" AND "DEF"

1. Defective wipers or board in control head circuit board switch.
2. Open in control head wiring harness.
3. Open in by-pass circuit in wiring harness (refer to electrical circuit diagram, Fig. 1-54).

BLOWER OPERATES WITH IGNITION OFF

1. Defective blower relay (closed contacts).

BLOWER SPEEDS SKIPPED IN "AUTO" SETTING

1. Open resistor on programmer blower circuit board.

NO HEATER TURN-ON IN COLD WEATHER EXCEPT IN "VENT" AND "DEF"

1. Electrical disconnect at heater turn-on switch (located at front of R.H. cylinder head).
2. Defective heater turn-on switch (will not close). Check by grounding switch feed wire.
3. If problem persists, refer to electrical circuit diagrams for wiring discontinuity.

NOTE: If problem does not occur in garage, it is probable that the system is turned on by the in-car sensor. Disconnect control head electrical connector to disarm the in-car switch. If the blower turns off (with the engine warmed up), ground the heater turn-on switch feed wire. If the blower now turns on (in low blower speed), the heater switch is probably defective.

IMMEDIATE HEATER TURN-ON IN COLD WEATHER

1. Defective (closed) heater turn-on switch (remove and check cold).
2. Defective (closed) in-car switch.
3. If problem persists, refer to electrical circuit diagram, and trace wiring continuity.

A/C DELAYED IN HOT WEATHER UNTIL ENGINE WARMS UP (UNLESS CONTROL LEVER IS IN "VENT" OR "DEF"

1. Defective (open) in-car switch.
2. Open in control head wiring harness (in-car switch circuit).
3. If problem persists, check wiring continuity in the in-car switch circuit. Refer to the wiring diagram, Fig. 1-4.

4. Auxiliary Vacuum Problem Diagnosis

Auxiliary vacuum functions are defined as those vacuum circuits in the automatic temperature control system which do not affect the temperature of discharge air. Specifically that would include all vacuum functions except the transducer, relay portion of the vacuum checking relay, and the programmer vacuum motor. Included in this section is one auxiliary electrical circuit, the compressor actuation circuit. A list of the auxiliary circuits is as follows:

1. Upper mode door vacuum circuit.
2. Lower mode door vacuum circuit.
3. Defroster bleed vacuum circuit.
4. Defroster door vacuum circuit.
5. Recirc door vacuum circuit.
6. Heater water valve vacuum circuit.
7. Auxiliary vacuum circuit check valve.
8. Compressor electrical circuit.

Refer to the controls portion of the theory of operation section for a brief explanation of each function and separate circuit diagrams.

Because of the relative simplicity of each of the auxiliary vacuum circuits, the best diagnostic aid will be a clear understanding of the type of problem or complaint which would result from a malfunction in any of the individual circuits. Once the problem has been isolated to a specific circuit, diagnosis will generally consist of checking vacuum connections at one or two points. The following chart presents the types of problems most likely to be encountered in each of the auxiliary circuits. For more complex problems a procedure to completely qualify the vacuum system is presented in the last block of the diagnosis chart.

It should be noted that because of the interrelationship of the vacuum circuits, a leak in one circuit may reduce the vacuum supply to another circuit sufficiently to cause a malfunction of the second circuit. For example, a water valve hose disconnected may prevent the mode doors from moving full travel causing a split mode condition.

UPPER AND LOWER MODE DOOR ACTUATION PROBLEMS

The most likely malfunctions would be "no air conditioner operation" and "split mode operation". Vacuum is required to get air conditioner mode. Check the hose connections at the mode door upper and lower vacuum actuators. Split modes may occur because of malfunctions in either the upper or lower door circuit, or because of leaks in other auxiliary vacuum circuits. It is recommended that the external vacuum circuit test procedure listed later be used to isolate mode door vacuum problems.

DEFROSTER BLEED PROBLEMS

Actuation of the side (bleed) port of the defroster diaphragm is delayed by a porous flow plug inserted in the yellow-coded vacuum hose. Complaints relating to defroster bleed operation will generally be of two types:

1. No defroster bleed. Check hose connection at defroster bleed nipple of defroster vacuum actuator. If connections are satisfactory, porous plug is probably too restrictive. Replace plug. (Before installing new plug, check for vacuum in yellow line; and apply hose to nipple, without the plug, to check bleed door operation.)
2. Rapid fogging of windshield when heater turns on. Either there is no porous flow plug or installation of the plug is incorrect.

DEFROSTER DOOR ACTUATION PROBLEMS

The most common problem to be expected in this circuit would be "no air out of defroster outlets in "Def" setting". Vacuum to the defroster actuator is required for defroster operation.

1. Check hose connection (blue) at defroster actuator.
2. Check for vacuum at the control head purple hose.
3. If system stays in A/C mode at "Def", check vacuum circuit to determine why mode override did not occur. If problem persists, see vacuum circuit test below.

RECIRC AIR DOOR ACTUATION PROBLEMS

The most likely problem to be encountered will be "no recirc air in "Hi" lever setting". Vacuum is required to obtain recirc air. Check hose connection at recirc air door. Remove vacuum delay plug to check for adequate vacuum at "Hi" setting and 65° dial. If vacuum is available but door won't move with plug in circuit after approximately 3 minutes, replace plug.

HEATER WATER VALVE CONTROL PROBLEMS

The water valve is a normally open valve requiring vacuum to close off water flow. It would be very difficult for a customer to recognize a problem in the water valve circuit by "no heater water shut-off"; however, a leak in that circuit may manifest itself by reduced vacuum levels available in other vacuum functions. The most likely such complaint would be a split mode delivery. Use the external vacuum circuit test presented on page 1-11 to isolate vacuum problems.

AUXILIARY VACUUM CIRCUIT CHECK VALVE PROBLEMS

The check valve for the auxiliary vacuum circuit is located in the programmer checking relay assembly. A malfunction of this check valve will probably result in complaints of loss of a specific function (such as "A/C shuts off") during accelerations or mountain climbing. The check valve may be checked with the system operating by disconnecting and plugging the black hose feeding the programmer checking relay. The vacuum functions (a vacuum gage in the purple hose or the system in A/C mode) should hold. If they do not hold, reinstall the black hose; and pinch the purple hose. If the functions now hold, the check valve is bad. If the functions continue to leak down, there is a circuit leak further upstream. Use the auxiliary vacuum circuit test below to locate the leak.

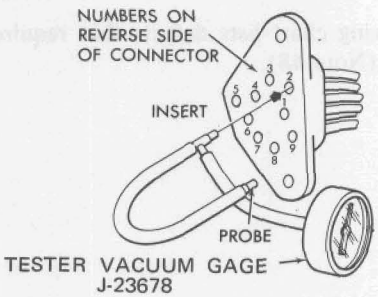
COMPRESSOR ELECTRICAL PROBLEMS

Malfunctions in the compressor electrical circuit would result in complaints of "no cooling", or "insufficient cooling". Perform the following checks:

1. Blown thermal fuse or disconnect at thermal fuse. Refer to Note 6.
2. Blown 15 amp fuse in fuse block.
3. Electrical disconnect at compressor clutch coil or clutch coil ground.
4. Electrical disconnect at compressor ambient switch. (Also disconnects ambient sensor which will bias the programmer to max. heat.)
5. Electrical disconnect at the three-way electrical connector inside the car, to the right of the programmer.
6. Backed-out terminal or misconnect at the control head electrical connector.
7. Defective compressor ambient switch.
8. Open in wiring harness. Refer to electrical circuit diagram, Fig. 1-4.

AUXILIARY VACUUM CIRCUIT TEST PROCEDURE

Remove car vacuum harness plug from programmer valve, which should direct all airflow to floor except for defroster bleed air. Connect tee with short hose and union to J-23678 tester vacuum gauge hose as shown in sketch at right, inseating tee in Part No. 2 of harness plug and probing each of the other ports in turn. Make sure that control head lever is set as specified for each step, and cover up probe on Ports 3 and 9 when called for, to seal off other circuit branches. For each step, full vacuum should be read after actuator-travel is completed.



Control Lever	Probe Port:	Hose Color	Cover Up	Other Hoses In Circuit	Action Expected
Bi-Level	None	Black	Probe	Yellow	Defroster door moves to "bleed" position
Bi-Level	1	White	None	None	Hot water valve closes - Check air in "max. heat"
Bi-Level	3	Red	Port 9	Purple, Tan	Lower mode door moves to A/C position
Bi-Level	4	Orange	None	None	Recirc. door opens - 1-2 min. delay
Lo	5	Chartreuse	Port 9	Purple	Checks control head vacuum leakage
Lo	6 or 8	Green	None	None	Upper mode door moves to A/C position
Hi	7	Dark Brown	None	Tan	Lower mode door moves to A/C position
Def	9	Purple	Port 3	Red, Dk. Blue	Defroster door moves to full "DEF" position

A low vacuum reading in any step indicates a leak in control head valve or in the hoses and components listed in that step. If some function is missing even though full vacuum is available, reconnect harness plug to programmer and check vacuum at extreme end of hoses involved, to distinguish between a pinched hose and a mechanical bind in actuator or door.

5. Refrigeration Problem Diagnosis

The sole function of the refrigeration system is to maintain the evaporator core cooling surfaces at 32°F. when refrigeration is required. A properly-operating refrigeration system will do this, if engine speed is sufficient and the heat load on the system is not excessive. A refrigeration problem exists when there is a defect in one of the refrigeration components or in the overall system which interferes with this function. In most cases, the defect will result in higher-than-normal core temperature and loss of effective cooling; in a few specific cases the core will operate at a temperature lower than 32°F. and condensate in the core will freeze and block air-flow, again causing a loss of cooling.

It is important to separate refrigeration problems from temperature control problems. This can be done simply during the brief lever setting check prescribed at the beginning of the diagnosis section. Proceed as follows:

1. Set lever at OFF-VENT-LO-AUTO-HI-BI-LEVEL-DEF and check for proper system operation, as described earlier.

2. If system operates properly, return lever to AUTO and set dial at 65°.

3. Install thermometer in center air conditioner outlet. Wait approximately one minute. Thermometer should read 40° to 50° unless temperature or humidity of test area are excessively high.

4. If the discharge temperature is significantly higher than 50°, disconnect vacuum hose assembly attached to the programmer. Check to assure that the air-mix door link arm is pivoted fully to the "Max" A/C position.

5. If the discharge air temperature drops to 50° or below as a result of disconnecting the hoses, the problem belongs in the Temperature Control category.

6. If the temperature does not change and is still significantly higher than 50°, a refrigeration problem exists.

Many refrigeration problems can be readily diagnosed without connecting the refrigeration gage set or performing the more extensive Cooling Capacity Performance Test listed in the standard service procedures. Defects causing a problems of this sort are listed in the following chart:

NO REFRIGERATION OR INSUFFICIENT REFRIGERATION

Gage set usage not required for diagnosis.

1. No voltage to compressor clutch - check thermal fuse. Refer to Note 6.
   Check compressor electrical circuit, including compressor ambient switch.
2. Compressor seized - clutch plate slips -
   Clutch plate moves rearward and engages pulley but pulley cannot drive it.
3. Compressor belts slipping.

The following chart lists defects that require connecting the gage set and running the Cooling Capacity Performance test (Note 48).

REFRIGERATION DIAGNOSIS CHART

Observe refrigeration system in areas listed below while engine operates at 2,000 RPM with control lever in "HI" and temperature dial at 65. Blower motor should be disconnected when required in chart.

System Defect	Outlet Air Temp. (in "HI")	Sight Glass	Head Pressure At Ambient Temperature	Evaporator Pressure	Evaporator Outlet Pipe (Ahead of STV)	Oil Bleed Line	System Correction
-No Defect- Normal	40-50°	Clear Bubbly with blower off	Temperature 70 80 90 100 160 190 220 250 200 230 260 290	29-32 P.S.I. Maintains press with blower disconnected	Cold	Warm Gets cold with blower disconnected	
Low Charge *	Warm	Foamy or Bubbly	Low	Normal to Low	Warm	Cold	Find and repair leak. Recharge
Lost Charge *	Warm	Clear	Very low	Very low	Warm	Warm	Find and repair leak. Recharge
Expansion valve *	Warm	Clear	Low	Low Goes to vacuum with blower disconnected	Warm	Warm	Replace X-valve
inlet screen ** plugged						Cold - Equalizer line also cold	Clean or replace inlet screen
Capillary ** broken (Valve * Closed).							
Capillary bulb- poor contact to pipe or bad insulation	Normal to Warm	Clear	Normal	High	Cold to Cool	Warm	Reclamp bulb at 3 o'clock location. Replace insulation
Suction throttling valve- setting too high	Warm	Clear	Normal	High Won't pull down with blower disconnected	Cool to Warm	Cold at low Ambient temp Warm at high Ambient temp	Replace STV
STV-Shut due* to loss of ** bellows vacuum or binds shut	Warm	Foamy to Bubbly	Normal	High	Warm	Warm Equalizer Line cold	Replace STV (Note: car with this defect will not take full charge)
STV - Stuck * Open	Cold May lose air flow on humid days	Clear	Low	High or Low Goes to vacuum with blower disconnected	Cold	Warm	Replace STV
Restriction in * receiver (Liquid line cold)	Warm	Bubbly	Low	Low	Cool or Warm	Cool or Warm	Replace receiver dehydrator
Over charge (blows relief valve on hot days)	Normal	Clear	High	Normal	Cold	Warm	Recharge to specification

*Can cause superheat switch to close and shut off compressor.

**Run test at least twice. Allow system to warm up and eqaulize before repeating. If condition doesn't recur, system has excess moisture causing ice to form in valve. Discharge, evacuate for 1/2 hour, recharge, Change dehydrator if necessary.

Listed below are a number of defects which will cause a relatively minor loss of capacity.

1. Excess bugs, leaves, etc. on condenser - Will cause higher-than-normal head pressure.
2. Excess oil in system.
3. Air in system - Will cause higher-than-normal head pressure. Will also cause internal corrosion of parts.

(NOTE: Let system stand inoperative overnight. With the same gage, check first the low side pressure and then the high side pressure. If the high side pressure is significantly higher than the low side pressure, there is probably air in the system. - Purge, evacuate and recharge.)

6. Low Refrigerant Detection System Diagnosis

A thermal fuse and superheat switch, designed to protect the air conditioning compressor against damage when the refrigerant charge is partially or totally lost, is incorporated on all cars.

During normal operation, current flows through the control head switch, ambient switch and thermal fuse to the clutch coil to actuate the compressor clutch. If a partial or total loss of refrigerant occurs in the system, the contacts in the superheat switch close, as the switch senses low system pressure and high suction gas temperature. When the contacts close, current flows to energize a resistor-type heater in the thermal fuse.

The resultant heat melts the fuse link and the circuit to the compressor clutch coil opens. Compressor operation ceases and damage due to loss of refrigerant charge is prevented.

Before thermal fuse replacement, the cause of the refrigerant loss must be corrected and the system charged.

DIAGNOSIS OF LOW REFRIGERANT DETECTION SYSTEM

Compressor will not operate if thermal fuse is blown. To check for blown fuse, remove harness connector and short between terminals "B" and "C" in the harness connector. If compressor now operates but did not before, thermal fuse is blown; proceed with Step 1. If compressor does not operate refer to compressor electrical problems on Page 1-11.

1. Inadequate Refrigerant Charge - Check for clear sight glass as described in Note 45. If refrigerant is low, eliminate leak and recharge. NOTE: Be sure to jump terminals B and C as above during recharging. Install new thermal fuse.
2. Thermal Fuse Was Blown During Previous Charging - Check to assure adequate refrigerant charge and install new thermal fuse.
3. Defective Expansion Valve (failed closed) - Replace expansion valve, recharge and install new thermal fuse.
4. Defective Superheat Switch - Before removing switch, check to assure a good electrical connection between switch case and compressor head. If ok, remove switch and check operation as follows: At temperatures below 100°F the switch should be open (open circuit between terminal and case). Switch should close with sensing tube held in match flame 15-20 seconds. If switch does not open and close as described, replace switch.
5. New thermal fuse blows immediately after installation is probably caused by short in wiring to switch. Possible causes of short are as follows:
   - A. Pinched, broken or bare wires.
   - B. Boot off of connector at switch.
   - C. Connector on thermal limiter reversed.
   - D. Connector shorted to switch body.
   - E. Refrigerant pipes cutting through boot at switch.
   - F. Connector off center on switch pin.
6. P.O.A. Defective (stuck open) - This condition can be diagnosed by running the engine at fast idle with the blower disconnected. Evaporator pressure pulls down considerably under the normal 29.5 P.S.I.

7. Use of the A.T.C. Tester—J-23678

The A.T.C. Tester, J-23678, is designed for on-car diagnosis of control problems utilizing car electrical and vacuum supplies. The Tester will not only locate the problem area but will also isolate the individual malfunctioning component.

How The Tester Functions

The Tester is inserted into the control system electrical and vacuum circuits at the programmer connections. The Tester is made up of the following four basic sections:

1. Manual Drive Control - A variable rheostat which replaces the sensor string when the "Automatic - Manual" rocker switch is in the "Manual" position. The rheostat can be varied to cause programmer movement, to analyze programmer operation, to adjust the feedback potentiometer, or to distinguish a sensor string defect from a programmer defect.
2. Voltmeter - Used to check programmer and blower voltages at connector terminals. A "probe and clip" position is also included to allow voltage readings elsewhere in the system.
3. Temperature Dial Calibrator - The temperature

dial setting (resistance) is checked by comparison to a master resistor in the Tester. Allows dial adjustment.

4. Vacuum Gage - Used to check vacuum anywhere in the system.

ALWAYS START DIAGNOSIS WITH BRIEF FUNCTIONAL TEST OF SYSTEM. Refer to section page 1-3 for test procedure.

Tester Procedure

a. Programmer Functional Test

1. Connect tester electrical harness to programmer and car harness to tester.
2. Operate car at idle. Approx. 1000 RPM.
3. Set control head lever at auto.
4. Turn temp. dial calibration switch off.
5. Place Manual automatic switch in manual position.

(NOTE: This substitutes variable resistor for sensor string. At all control head settings.)

6. Place the manual control at max. heat and then rotate slowly counter-clockwise. Vacuum motor mechanism which can be seen through the slot in the programmer cover should start moving at 180 OHMS. Rotating the knob to max. cold should move the programmer to its full A/C position. Check air-mix door for full travel, and no obstructions. If the programmer operates in this manner, the components govering programmer movement -- amplifier, transducer and vacuum motor -- are ok. Proceed to sensor string test.
7. If the programmer moves but the movement does not start at 180 OHMS, adjust feedback pot per procedure in Note 50c.
8. If the programmer does not move, check as follows for supply voltage and supply vacuum:

a. Place voltmeter switch in 2 position. Battery voltage should appear on meter. No voltage indicates lack of ground on term 1 or battery supply to term 2 of programmer.

b. Plug tester's dummy vacuum plug on programmer valve. Connect dummy hose to vacuum supply (Port 2 hose in car vacuum harness). Make sure vacuum is present (11 in. hg. or more). Programmer now has vacuum supply with no car vacuum system components connected. If programmer functions using manual control, troubleshoot car vacuum system. If programmer does not function, defects is in programmer. See Part E.

b. Sensor String Test (Do Programmer Functional Test First)

1. Set control lever at auto and temperature dial at 75.
2. Place temp. dial calibration switch at off.
3. Place manual-automatic switch at automatic position.
4. Observe position of vacuum motor mechanism through slot in programmer cover.
5. Switch to manual and adjust manual control for same mechanism position.
6. When manual control is properly adjusted, moving manual-automatic switch back and forth will not move vacuum motor.
7. Read manual control. This indicates the resistance of the sensors and the temperature dial combined and should be 100 to 150 OHMS at 70 to 75 room temp.
8. If reading is not 100 to 150 OHMS, perform the temperature dial calibration test to check out the temp dial. If temp. dial checks ok, the in-car or ambient sensor or connecting wiring is defective.

c. Temperature Dial Calibration

1. Place control lever at Vent position.
2. Place manual-automatic switch in manual position.
3. Place calibration switch in cal. position.
4. Read Voltmeter.
5. Press pushbutton and adjust temp. dial on control head to get same voltmeter reading as above.
6. Temp. dial should read as indicated on tester panel near pushbutton. If it does not, slip temp. dial clutch to correct. (NOTE: If same voltmeter reading cannot be obtained, the temp. dial is defective.)

d. Blower Circuit Tests

1. Place calibration switch in off position.
2. Place manual-automatic switch in manual position.
3. Set control lever at Lo. using voltmeter knob, there should be battery voltage at 7 and approx. half battery voltage at 6. If there is no voltage at 7, there is a defect in the Lo relay circuit. If there is voltage at 7 but no voltage at 6, the programmer is defective.
4. Set control lever at auto. there should be battery voltage at 8 and the voltage at 6 should stairstep down and then back up as the manual control is rotated from max. heat to max. cold. If full battery voltage is not obtained at 8, there is a defect in the auto relay circuit. If the voltage at 6 does not change as described, the programmer is defective. (NOTE: A good connection between 6 and the blower motor is assumed, if the blower wire is disconnected, only battery voltage will appear at 6.)

e. Programmer Vacuum Circuit

(NOTE: Diagnosing defects in programmer. The following tests should be performed to determine a defective internal part. Tests should be made in the lettered sequence.)

Remove electrical connector from programmer. If programmer moves to max. heat position, skip to Part f, otherwise, perform following test:

1. Remove programmer cover, install dummy vacuum plug with vacuum gauge teed-in to port 2 of car harness plug.
2. If vacuum drops below supply vacuum found in programmer functional test, use long-nose pliers to pinch the two black hoses leading from side of rotary valve. If vacuum reading improves, check programmer hoses for leaks, then go to Part f.
3. If reading does not improve, leak is in rotary valve.

f. Vacuum Motor And checking Relay

1. Disconnect electrical connector from programmer. Programmer should go to full heat.

2. Disconnect vacuum dummy plug or car vacuum harness from programmer. Vacuum checking relay should hold vacuum motor in full heat. If mechanism moves, vacuum motor or checking relay is leaking. Apply raw vacuum to vacuum motor then pinch hose at motor to see if leak is in motor.

g. Amplifier And Transducer

1. Connect tester harness to system. Place manual automatic switch in manual and temp. dial calibration switch in off position.

2. Place voltmeter switch in probe and clip position connect clip to transducer terminal with grey wire.

CAUTION: Do not short transducer terminals together or amplifier will be damaged.

Push probe into programmer connector body making contact with terminal 2 (Yellow Wire).

3. Rotating the manual control from max. heat to max. cold. The voltage reading should change 5 volts or more for a good amplifier. If amplifier checks bad, check position of mylar insulator on side of amplifier.

h. Transducer Test

1. Connect tester and leads same as in amplifier test (Part g).

2. 11 in. hg. or more vacuum should be present on small transducer supply hose.

3. To check output regulated vacuum, connect vacuum gauge to white striped hose from transducer at vacuum checking relay. Use large tee to make connection: seal extra port with thumb.

4. Rotate manual control to get 0 volts on voltmeter. Turning manual control to max. cold should make vacuum drop to 0 in. hg. Reconnect hoses.

i. Feedback Potentiometer Adjustment

1. Using screwdriver, slip feedback pot shaft counter-clockwise to stop (gear does move). Programmer should move to full heat.

2. Place manual-automatic. Switch in manual position. Rotate manual control to max. heat.

3. Move manual control to 180. Do not over-travel.

4. Slip feedback pot shaft slowly clockwise looking for signs of vacuum motor mechanism movement.

5. Check adjustment with manual control. Travel should start when 180 is reached as knob is turned counter-clockwise from max. heat.

6. If feedback pot cannot be adjusted, replace amplifier assembly.

j. Blower Switch Bench Test. (Using J-23713 Bench Test Harness)

The ATC Programmer Test Harness, J-23713, is a substitute blower motor resistor that is used with ATC Tester, J-23678, a vacuum supply and a 12-volt source to bench-test the programmer, Fig. 1-5.

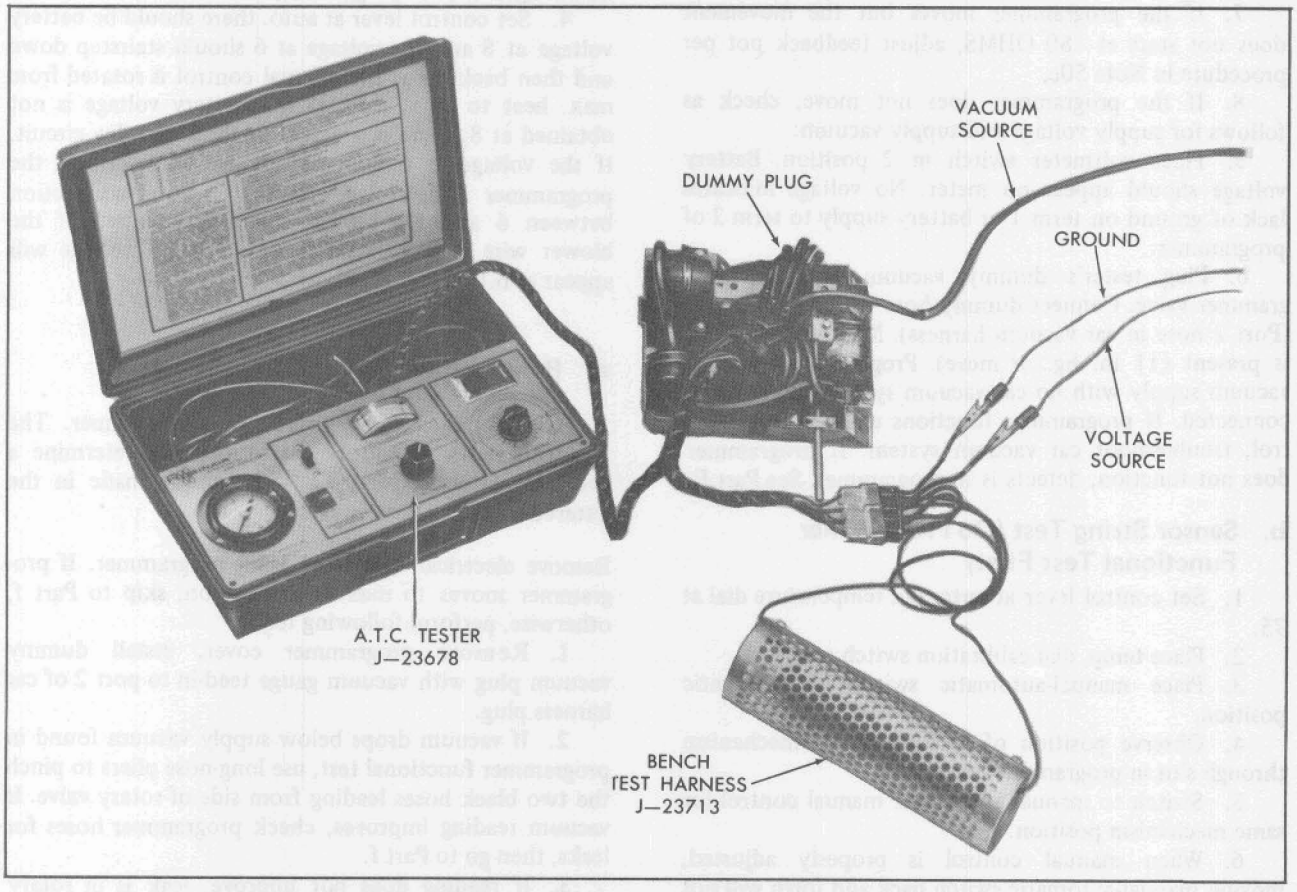


Fig. 1-5 Bench Test Harness

1. With ATC Programmer on bench, plug harness of ATC Tester, J-23678, into programmer electrical connection.
2. Plug Harness (substitute blower resistor), J-23713, into female plug of harness on Tester, J-23678.
3. Connect positive and negative leads of J-23713 Harness to a voltage source.
4. Connect dummy vacuum plug provided with J-23678 into vacuum source.
5. Place voltmeter knob of J-23678 at 6 and place manual-automatic switch in manual position.
6. Rotate manual control knob back and forth (from max. cold to max. A/C). Voltage should drop, then increase, in steps. Voltage variation will be less than when performed on car.

k. Programmer Moves But Vacuum Operated Door(s) Malfunction

If one of the doors does not operate, malfunction could be caused by plugged or pinched harness or plugged valve on programmer. To check programmer valve, cut off sealed hose on dummy plug for circuit malfunctioning and connect the vacuum gauge to the plug. Plug the dummy plug on the programmer vacuum valve. Connect dummy hose to vacuum supply hose (Port 2) in car vacuum harness. Monitor vacuum while operating programmer with manual control. When completed, seal dummy plug hose with rivet. Do not use a screw, refer to Fig. 1-53 for proper vacuum valve operation.

l. Temperature Door Check And Adjustment

A mis-adjusted temperature door link may not allow the programmer to travel fully to max. heat or to max. cold and could result in poor heating or poor cooling complaints. To check adjustment, attach tester electrical harness between programmer and car harness. Put manual-automatic switch in manual and control lever in auto. Put voltmeter knob in 6. Rotate manual control from max. heat to max. cold; high blower (Battery Voltage) should be obtained in both extremes. With control lever in high, recirc. operation should be obtained at max. cold (3 min. delay on some cars). With these conditions met, temperature door adjustment is correct. To readjust:

1. Start engine and put control lever in Def.
2. Loosen screw on programmer shaft.
3. Remove electrical connector from programmer. Programmer should go to full heat.
4. Move temperature door to full heat position by pushing door link away from programmer. The blower air will hold door.
5. Tighten screw and re-check as above.

THEORY OF OPERATION FRONT AIR CONDITIONER—ALL SERIES

Air conditioning is standard equipment on the Fleetwood Seventy-Five Sedan and Limousine and optional on all other series cars. The front system is the same for all series, with the following few exceptions:

- Specific refrigerant hoses for the Eldorado and 75 Series
- Specific heater water hoses for the Eldorado and 75 Series
- Specific condenser and receiver for the Eldorado

75 Series cars are equipped with a rear heating and air conditioning and temperature control system which operates completely independent of the front system. It is "teed" into the front system at the heater water and refrigerant feed and return lines. This section contains information on the front system; information on the Series 75 rear system and on the standard Heating and Ventilating system in the non-A/C car is contained in the last two sections; see Table of Contents.

The location of most of the air conditioner components is shown in Fig. 1-6 and 1-7. The information on theory of operation that follows will cover the air delivery system, the refrigeration system and the automatic temperature control system.

Air Delivery System

In normal operation, air utilized by the system is drawn into the body air plenum through openings at the base of the windshield and directed to the air inlet which is located inside the plenum on the right side of the body. From the air inlet, the air enters the blower which directs it through the evaporator where it is filtered, dehumidified and cooled to approximately 35°F. It is then "reheated" as required by being passed through and around the heater core. This air is then directed by air doors in the heater assembly to the air conditioner outlets in the instrument panel, to the heater distributor at floor level or to the defroster outlets. Air exhausts from the body by passing through the air exhaust grilles located in the door lock pillars. This provides positive air flow even when windows are closed. The components comprising the air delivery system are listed and described below.

a. Air Inlet

The air inlet which is attached to the rear surface of the blower scroll and located inside the body air intake plenum is composed of a plastic housing, an air door and a vacuum actuator that controls the position of the door. See Fig. 1-6. The door has two positions -- with no vacuum applied to the actuator, the door is in a rearward position, blocking off the recirculating air opening and allowing only outside air to enter the blower. When vacuum is applied to the actuator, the door is moved to a forward position where it blocks most of the outside air and allows approximately 80% of the total air supply to be recirculated from the passenger compartment.

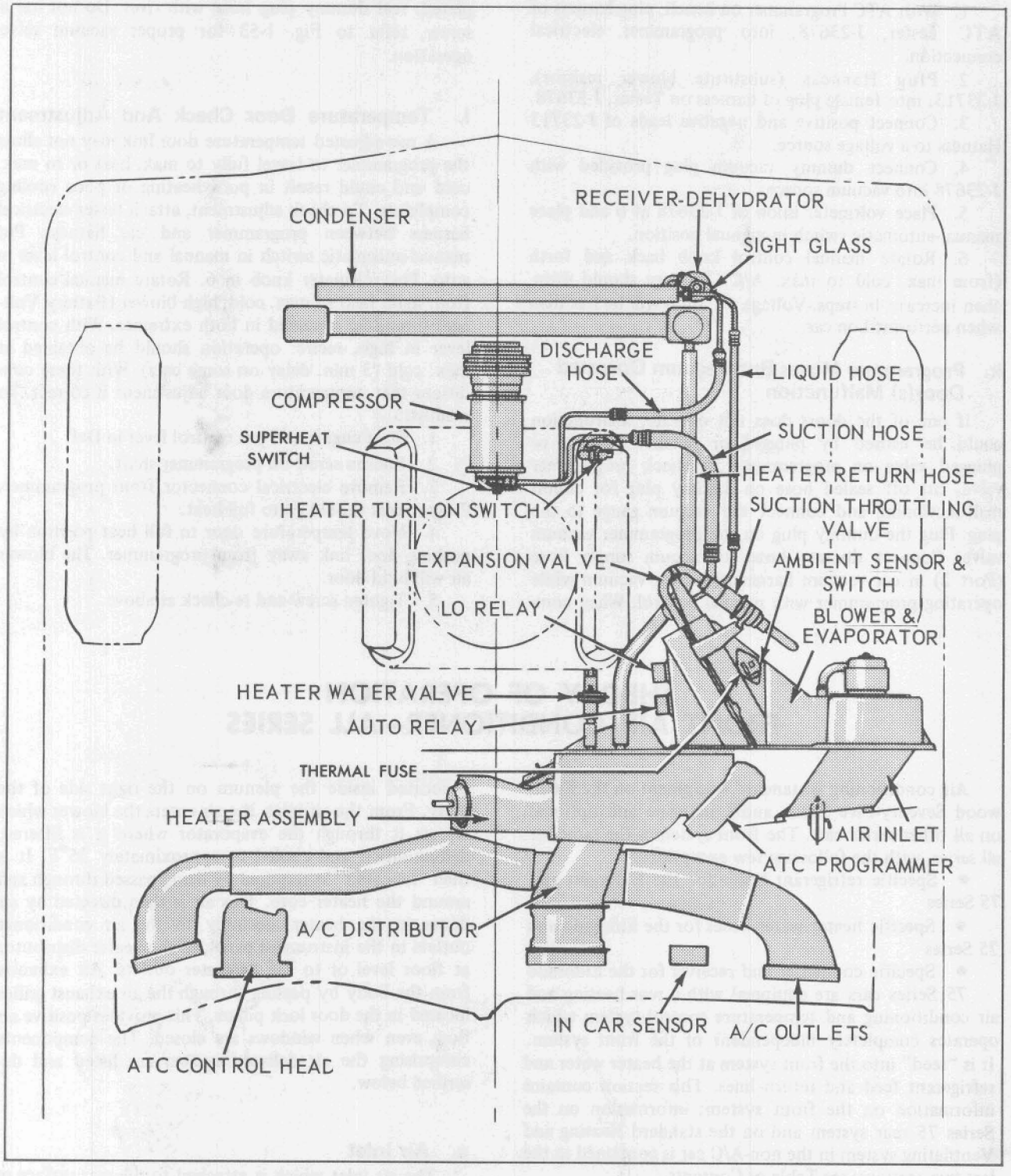


Fig. 1-6 Location of Air Conditioner Components

b. Blower and Evaporator

The blower and evaporator, shown in Fig. 1-8, is located in the engine compartment on the right side of the cowl. This assembly consists of a plastic housing, a squirrel-cage type blower, the evaporator core and two refrigerant control valves.

The evaporator core, which is aluminum and similar in construction to the car radiator, is the actual cooling unit of the system. The blower draws air from the air inlet and forces it through the evaporator core where it is cooled and dehumidified. A molded rubber tube on the bottom of the housing allows condensate to drain from the housing. The blower is air cooled -- a small

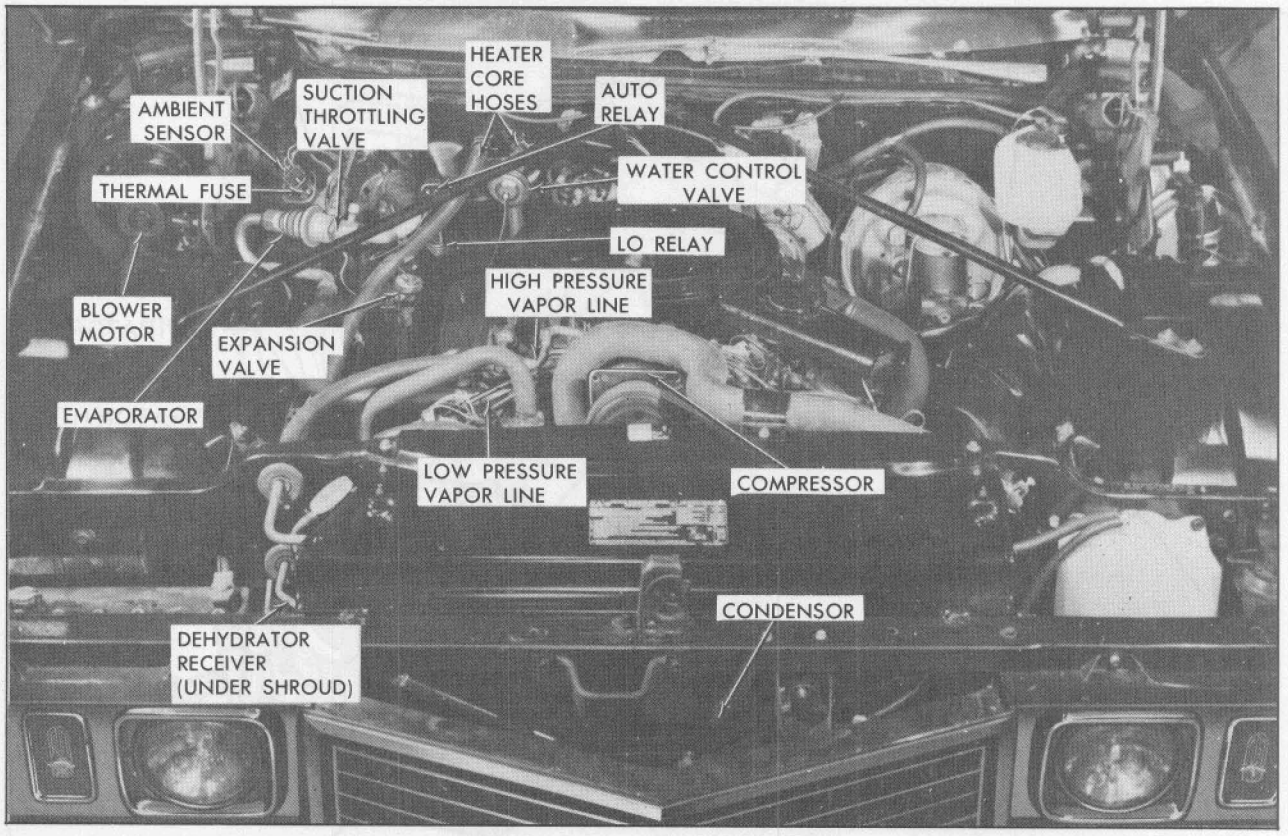


Fig. 1-7 Air Conditioner Underhood Units On Car

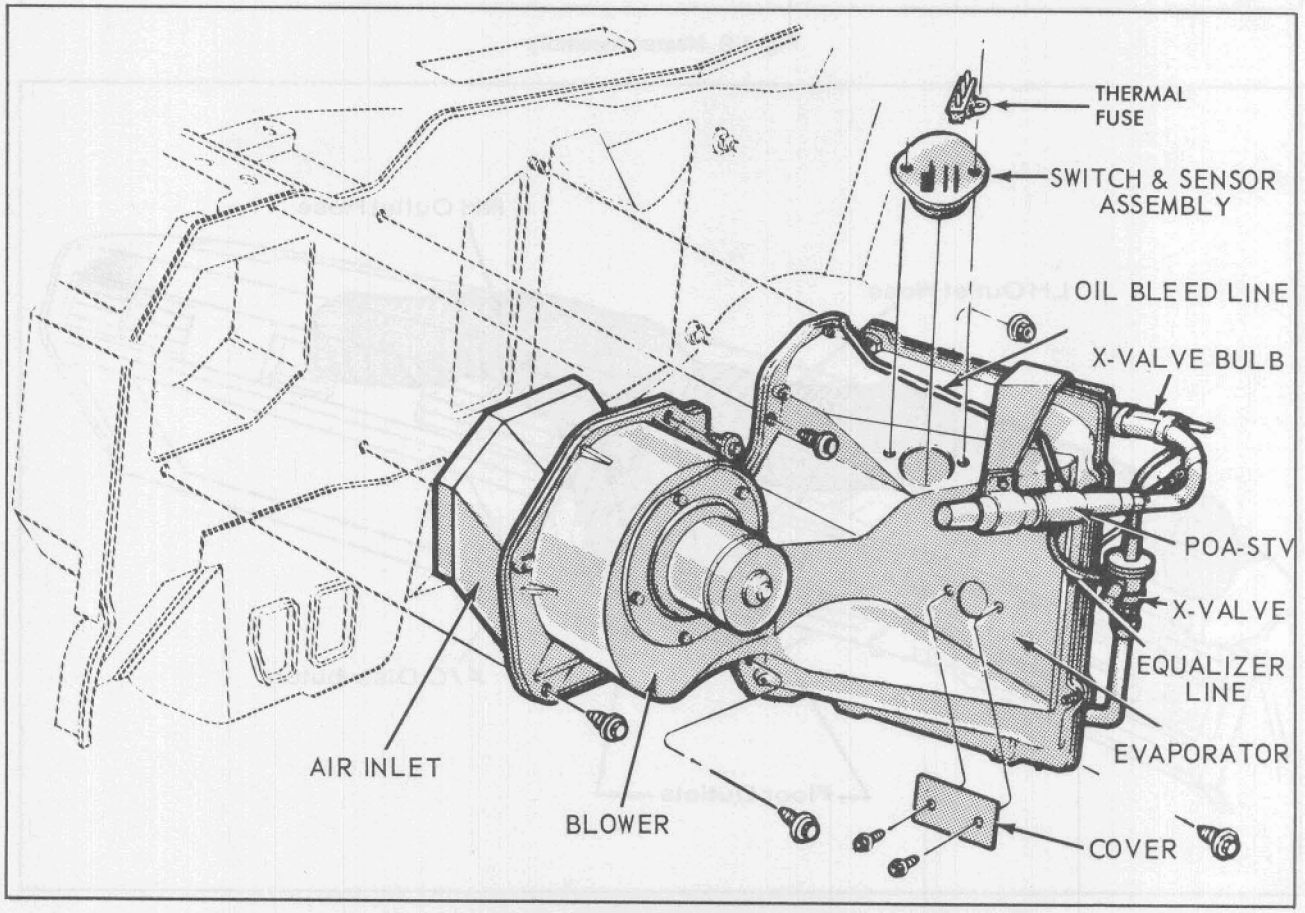


Fig. 1-8 Air Inlet, Blower and Evaporator

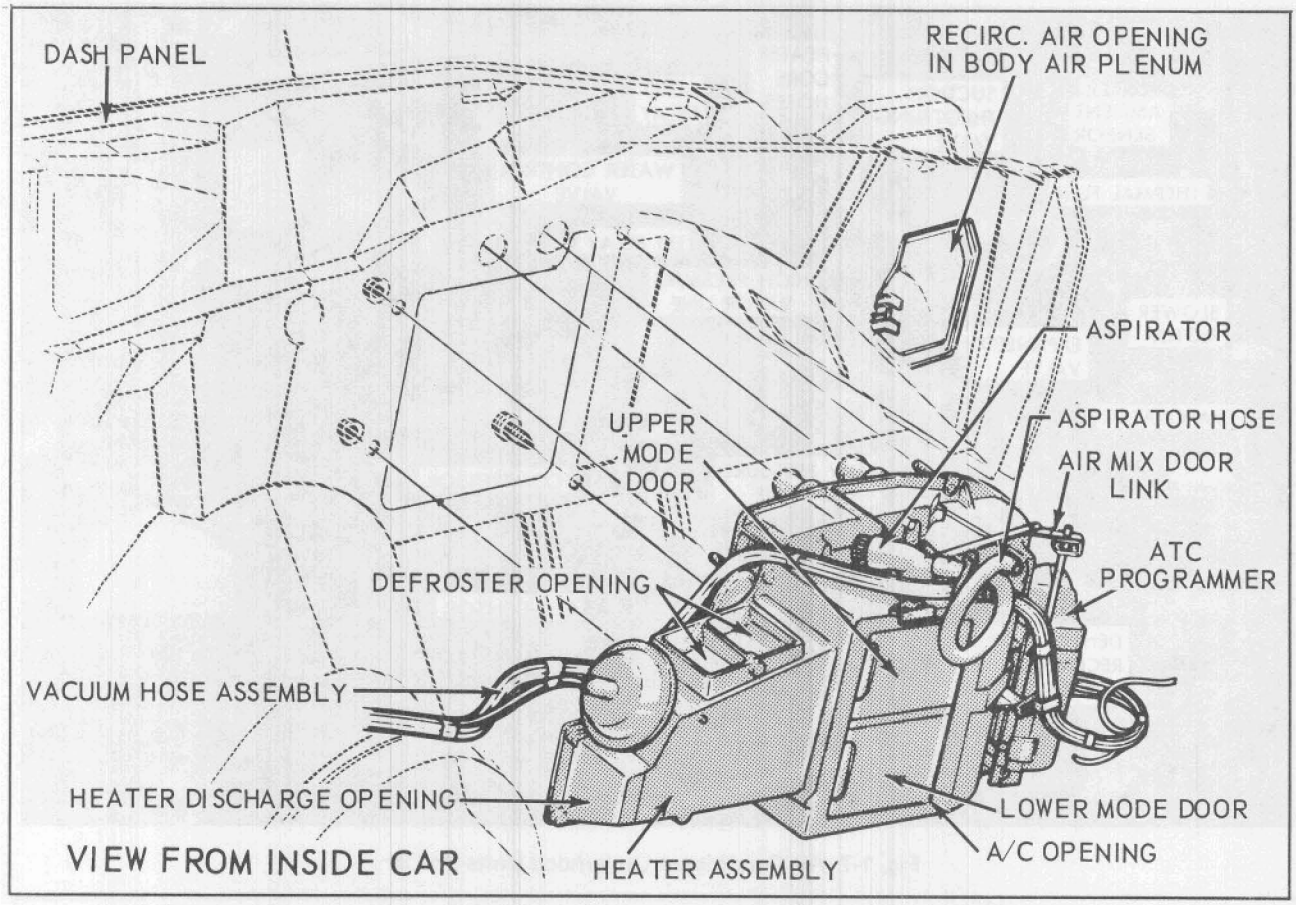


Fig. 1-9 Heater Assembly

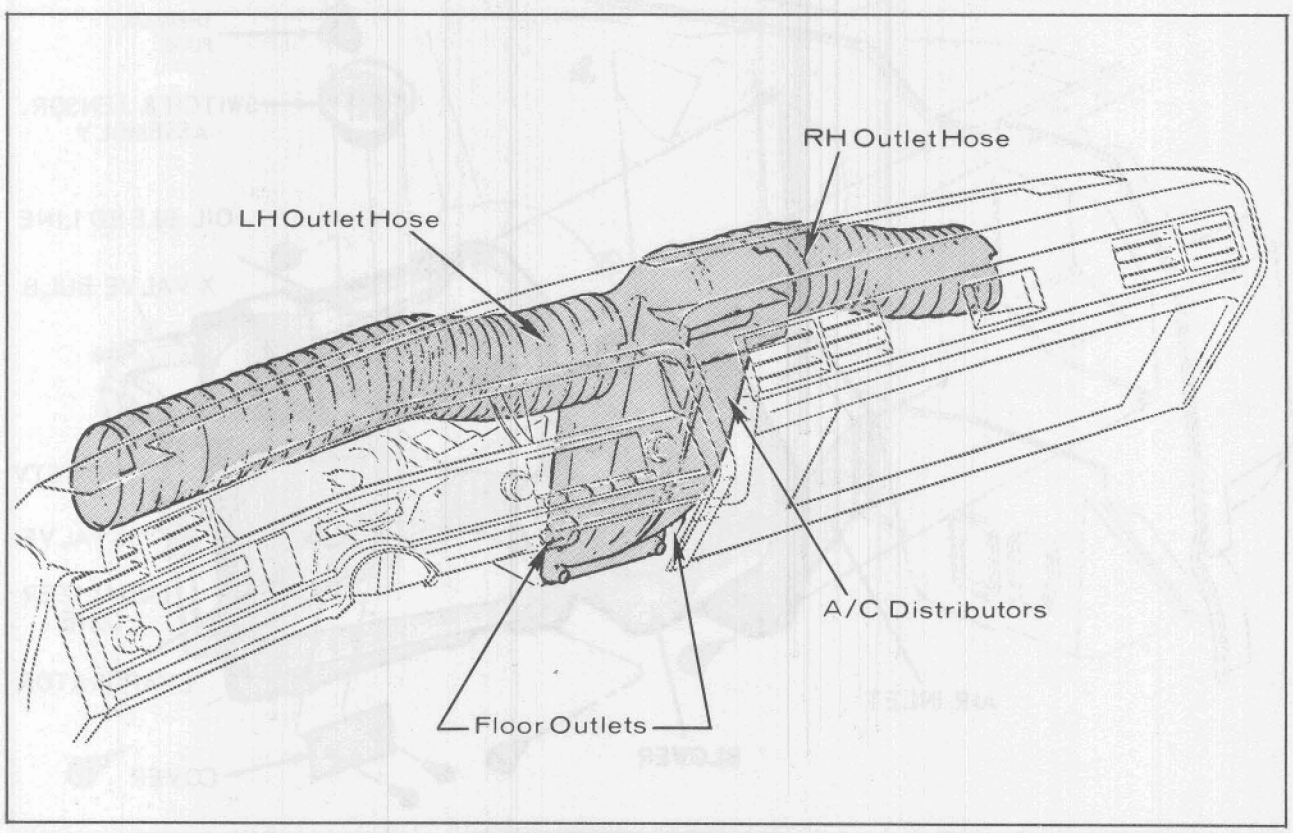


Fig. 1-10 A/C Distributor and Ducts

portion of blower output air is recirculated through the motor housing via a rubber tube.

c. Heater

This assembly, shown in Fig. 1-9, is located inside the passenger compartment under the right-hand side of the instrument panel. It consists of a sheet metal and plastic housing, a heater core, an air-mix door which is controlled by the ATC (automatic temperature control) programmer, an upper and a lower mode door, each controlled by a vacuum actuator, and a defroster door which is controlled by a two-stage vacuum actuator.

Cold, dehumidified air from the evaporator enters this assembly through an opening in the dash panel and is reheated, as required, by the heater core. The air-mix door controls the amount of reheat that takes place. In one of its end positions it forces all the air from the evaporator to flow through the hot heater core -- the resulting air stream is very hot. In the extreme opposite position, the door forces all the air to bypass around the heater core so that no reheat takes place and the resulting air stream is very cold. In intermediate positions, some of the air passes through the heater core and some bypasses it, so that the resulting air stream is mixed to the desired temperature.

The air stream is next directed by two mode doors so that it either flows out an opening in the rear surface of the heater case and into the A/C distributor or it continues to flow to the left toward the heater distributor. The two mode doors operate in unison most of the time, causing air to be discharged either from A/C outlets or from the heater distributor; however, when the control head lever is set at "Bi-Level", the upper mode door is not actuated and allows part of the air stream to continue on to the heater distributor while the lower mode door is actuated and positions itself to cause the remainder of the air stream to enter the A/C distributor and be delivered from the A/C outlets. This type of air delivery is referred to as bi-level air delivery.

The defroster door located at the left-hand end of the heater is operated by a two-stage vacuum actuator and has three positions. With vacuum applied to the side port of the actuator, the door is pulled down slightly so that it intercepts only a small amount of air to be diverted to the defroster outlet. When vacuum is applied to both the side and center ports, the door is pulled full down and intercepts most of the air that would normally go to the heater distributor.

d. Air Conditioner Distributor

The A/C distributor is a large plastic duct attached to the rear surface of the heater. It receives air from the heater and distributes it to the left-hand and right-hand A/C outlets through flexible air hoses and to the center outlet through a rubber boot. See Fig. 1-10.

e. Air Conditioner Outlets

Three dual outlets are located in the instrument panel, one at the left side of the cluster and two in the insert area of the panel top cover. See Fig. 1-11. Each outlet provides two air streams whose direction can be controlled independently by the knobs on the outlet.

A moderate flow of cool air to the floor is provided by two small plastic outlets located on the sides of the A/C distributor. These outlets can be rotated to obtain a more indirect flow of air to the floor area, if desired.

f. Heater Outlet

The heater outlet is attached to the bottom surface of the heater case at centerline of car. It distributes air to the left-hand and right-hand sides of the front floor and also directs two heavy streams of air under the front seat to heat the rear compartment.

g. Defroster Nozzle

A unitized defroster nozzle, shown in Fig. 1-13. delivers defrosting air to both sides of the windshield. It is attached to the top of the heater case near centerline

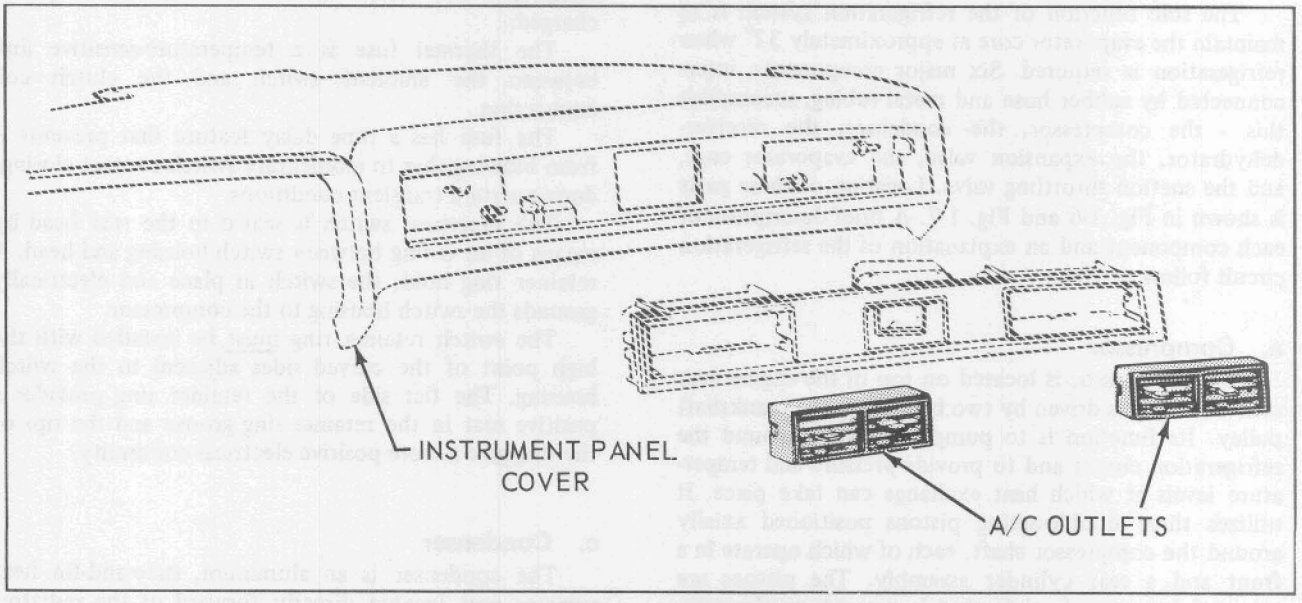


Fig. 1-11 Air Conditioner Outlets

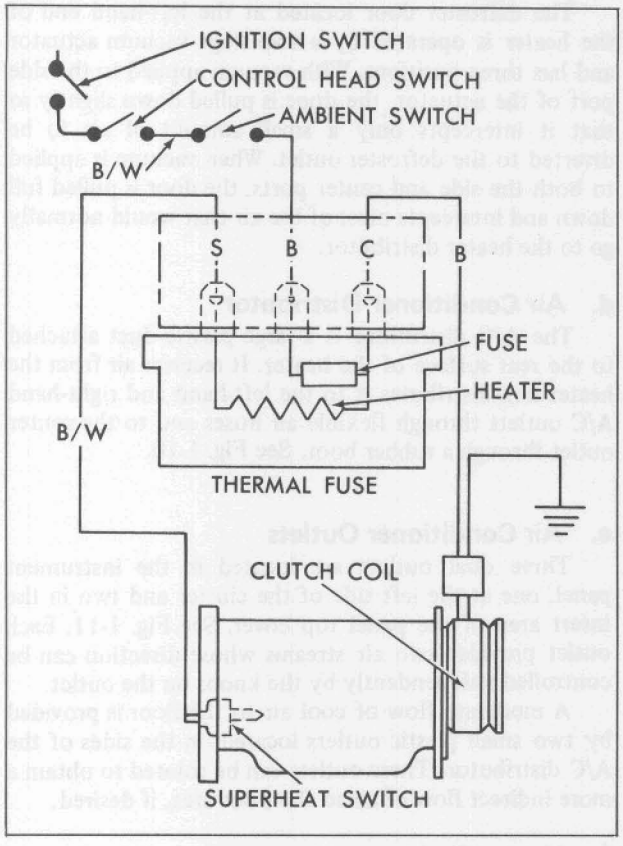


Fig. 1-12 Low Refrigerant System Electrical Circuit

with one screw and is indexed to the lower windshield frame by twist tabs.

h. Air Flow Diagrams

Air flow through the system in various typical situations is shown in Fig. 1-18 through 1-24.

REFRIGERATION SYSTEM

The sole function of the refrigeration system is to maintain the evaporator core at approximately 32° when refrigeration is required. Six major components, interconnected by rubber hose and metal tubing, accomplish this - the compressor, the condenser, the receiver-dehydrator, the expansion valve, the evaporator core, and the suction throttling valve. Location of these parts is shown in Fig. 1-6 and Fig. 1-7. A brief description of each component and an explanation of the refrigeration circuit follow.

a. Compressor

The compressor is located on top of the engine near centerline and is driven by two belts from the crankshaft pulley. Its function is to pump refrigerant around the refrigeration circuit and to provide pressure and temperature levels at which heat exchange can take place. It utilizes three double-acting pistons positioned axially around the compressor shaft, each of which operate in a front and a rear cylinder assembly. The pistons are actuated by a swash plate that is pressed on the compressor shaft, Fig. 1-14. The cylinders have a bore diameter of 1-1/2 inches and a stroke of 1-3/16 inches, providing a total piston displacement of 12.6 cubic inches. Suction and discharge valve plates are located at the forward end of the front cylinder block and at the rear of the rear cylinder block.

A magnetic clutch is used to drive the compressor shaft. When voltage is applied to the clutch coil, the clutch plate and hub assembly, which is solidly coupled to the compressor shaft, is drawn by magnetic force rearward toward the pulley which rotates freely on the front head casting. The magnetic force locks the clutch plate and pulley together as one unit. The compressor shaft then turns with the pulley. When voltage is removed from the clutch coil, springs in the clutch plate and hub assembly move the clutch plate away from the pulley and the clutch plate and compressor shaft cease to rotate.

b. Low Refrigerant Detection System

A thermal fuse and superheat switch, designed to protect the air conditioning compressor against damage when the refrigerant charge is partially or totally lost, is incorporated on all cars. The thermal fuse is mounted on the top of the evaporator case near the ambient sensor (Fig. 1-6), and the superheat switch is located in the rear head of the compressor, (Fig. 1-12). The fuse and switch are connected in series by an electrical lead.

During normal A/C system operation, current flows through the control head switch, ambient switch and thermal fuse to the clutch coil to actuate the compressor clutch. If a partial or total loss of refrigerant occurs in the system, the contacts in the superheat switch close, as the switch senses low system pressure and high suction gas temperature. When the contacts close, current flows to energize a resistor-type heater in the thermal fuse.

The resultant heat melts the fuse link and the circuit to the compressor clutch coil opens. Compressor operation ceases and damage due to loss of refrigerant charge is prevented.

Before thermal fuse replacement, the cause of the refrigerant loss must be corrected and the system charged.

The thermal fuse is a temperature-sensitive link between the ambient switch and the clutch coil connection.

The fuse has a time delay feature that prevents it from blowing due to momentary switch contact closings during certain transient conditions.

The superheat switch is sealed in the rear head by means of an O-ring between switch housing and head. A retainer ring holds the switch in place and electrically grounds the switch housing to the compressor.

The switch retainer ring must be installed with the high point of the curved sides adjacent to the switch housing. The flat side of the retainer ring provides a positive seat in the retainer ring groove and the tips of the ring give a more positive electrical continuity.

c. Condenser

The condenser is an aluminum, tube-and-fin heat transfer unit located directly forward of the radiator. The function of the condenser is to transfer heat from

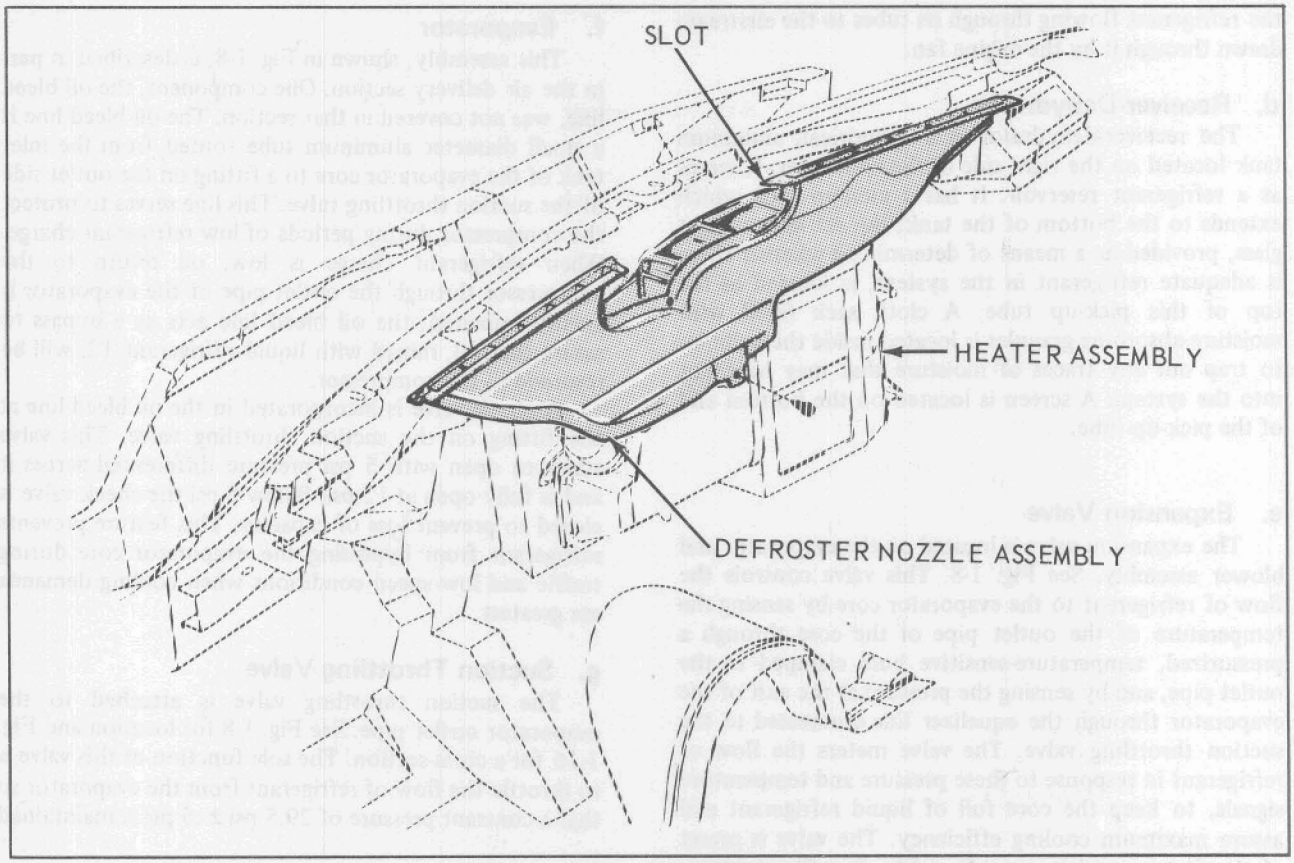


Fig. 1-13 Defroster Nozzle

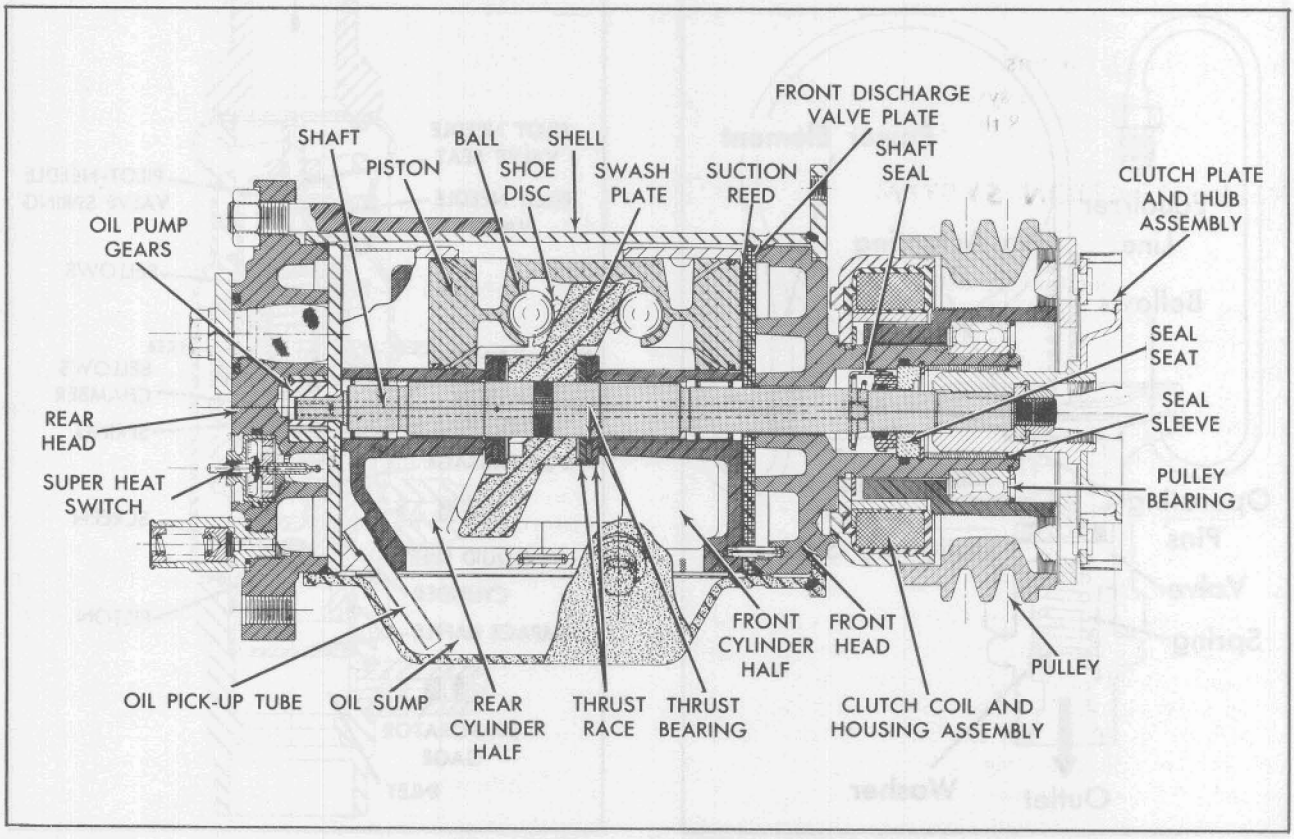


Fig. 1-14 Compressor Cross Section

the refrigerant flowing through its tubes to the airstream drawn through it by the engine fan.

d. Receiver-Dehydrator

The receiver-dehydrator is a cylindrical, aluminum tank located on the right side of the condenser. It serves as a refrigerant reservoir. It has a pick-up tube which extends to the bottom of the tank; the refrigerant sight glass, provided as a means of determining whether there is adequate refrigerant in the system, is located at the top of this pick-up tube. A cloth sack filled with moisture-absorbing granules is located inside the cylinder to trap out any traces of moisture that may have got into the system. A screen is located on the bottom end of the pick-up tube.

e. Expansion Valve

The expansion valve is located on the evaporator and blower assembly. See Fig. 1-8. This valve controls the flow of refrigerant to the evaporator core by sensing the temperature of the outlet pipe of the core through a pressurized, temperature-sensitive bulb clamped to the outlet pipe, and by sensing the pressure at the exit of the evaporator through the equalizer line connected to the suction throttling valve. The valve meters the flow of refrigerant in response to these pressure and temperature signals, to keep the core full of liquid refrigerant and assure maximum cooling efficiency. The valve is preset at the factory and is not adjustable. See Fig. 1-15 for cross section of valve.

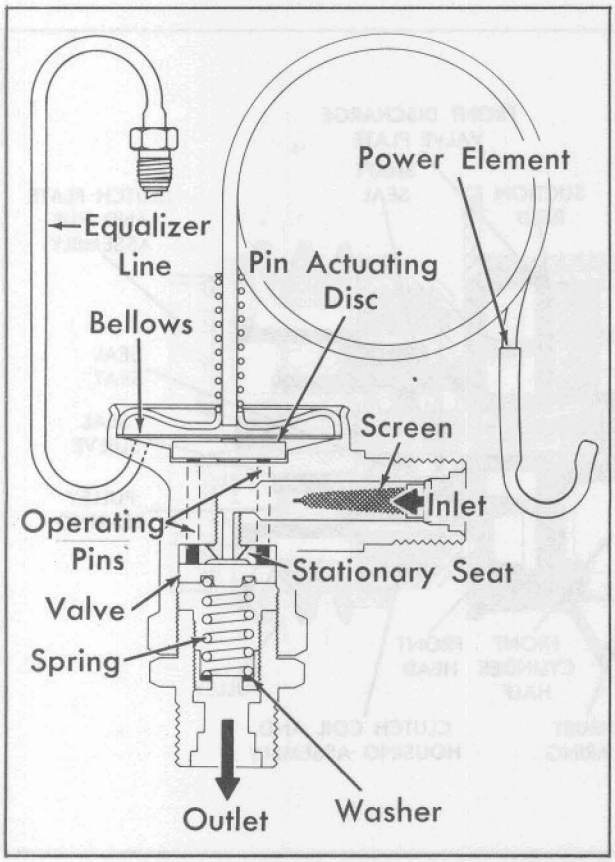


Fig. 1-15 Expansion Valve

f. Evaporator

This assembly, shown in Fig. 1-8, is described in part in the air delivery section. One component, the oil bleed line, was not covered in that section. The oil bleed line is a small diameter aluminum tube routed from the inlet tank of the evaporator core to a fitting on the outlet side of the suction throttling valve. This line serves to protect the compressor during periods of low refrigerant charge. When refrigerant charge is low, oil return to the compressor through the outlet pipe of the evaporator is greatly impaired; the oil bleed line acts as a bypass to assure that oil, mixed with liquid refrigerant 12, will be returned to the compressor.

A check valve is incorporated in the oil bleed line at the fitting on the suction throttling valve. This valve starts to open with 5 psi pressure differential across it and is fully open at 12 psi. Below 5 psi the check valve is closed to prevent loss of capacity. This feature prevents refrigerant from bypassing the evaporator core during traffic and low speed conditions when cooling demands are greatest.

g. Suction Throttling Valve

The suction throttling valve is attached to the evaporator outlet pipe. See Fig. 1-8 for location and Fig. 1-16 for a cross-section. The sole function of this valve is to throttle the flow of refrigerant from the evaporator so that a constant pressure of 29.5 psi ± .5 psi is maintained

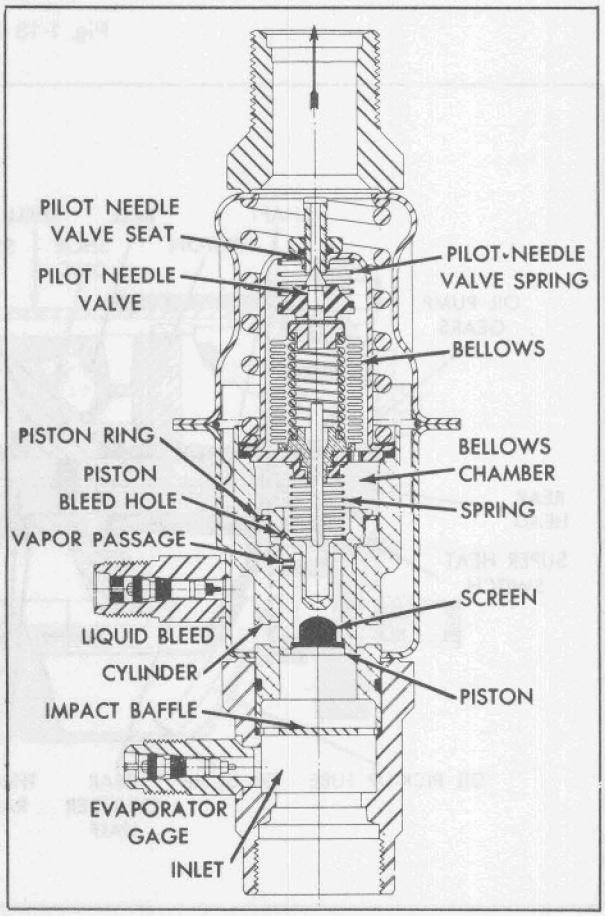


Fig. 1-16 Suction Throttling Valve

in the core. At this pressure the evaporator tubes and fins are maintained at approximately 32°F. If the pressure in the core were allowed to drop much below 29.5 psi, ice would form in the core and block air flow. The capability of the valve to maintain 29.5 psi is, of course, limited by compressor capacity; at low compressor speed and high evaporator load the evaporator pressure may be greater than 29.5 psi, and the valve will be wide open.

The valve is controlled in operation by opposing forces on the valve piston; evaporator pressure on one side of the piston is opposed by spring pressure and control pressure on the other side.

When evaporator pressure rises above 29.5 psi, this pressure is exerted against the piston and, by means of a small bleed hole in the piston, into the bellows chamber, where it is reduced to control pressure by the bellows-operated pilot needle valve. This evaporator pressure overcomes both the spring pressure and control pressure, causing the piston to open until a balanced position is reached, at which evaporator pressure returns to the setting desired.

When evaporator pressure drops below 29.5 psi, spring pressure overcomes evaporator pressure, causing the piston to close down until the evaporator pressure returns to 29.5 psi.

h. Refrigeration Cycle

Refer to Fig. 1-17 for a generalized schematic of the refrigeration system showing relationship of components. The compressor discharges high temperature, high pressure vapor that contains heat absorbed in the evaporator plus heat imparted to it by the compressor in the compression process. This vapor flows through two parallel tubes in the condenser where it releases heat to the airstream and changes to a medium temperature high pressure liquid. This liquid flows to the receiver-dehydrator; from there it flows through the pickup tube past a sight glass and through the liquid line to the expansion valve on the evaporator assembly. At the flow control orifice in the expansion valve, the medium temperature, high pressure liquid changes to a low temperature, low pressure liquid and vapor mixture. This cold, foamy mixture enters the evaporator core at the bottom end and flows through parallel tubes upward through the core. Heat from the warm air-stream passing through the core is transferred to the refrigerant, vaporizing the liquid. Under high load conditions all the liquid is vaporized in the evaporator and only vapor flows through the suction throttling valve and the suction line to the compressor. The heat-laden vapor is drawn into the compressor and the cycle is repeated.

Temperature Control System

Control Panel Settings

The temperature control system provides automatic regulation of the car interior temperature regardless of outside temperature changes. The control panel, Fig. 1-26, consists of a temperature dial with a range of 65°F to 85°F and a single sliding lever to permit the customer to choose various modes of operation. The "Auto" setting is recommended for most situations since it provides high blower operation for quick cooldowns or warmups and yet modulates down in blower speed when the temperature on the dial has been reached. There are six additional settings which provide customer control for unusual conditions. An explanation of the system operation at various lever settings begins on page 1-27.

Control System Components

Following is a complete list of the components which comprise the temperature control system. The location of the part is given together with a brief description of how the part works. System operation and how the various components interact within the system is explained in a subsequent section.

a. Control Panel

The control panel, Fig. 1-26, is located in the instrument panel cluster to the left of the steering column and consists of a diecast bezel, a diecast baseplate, an acrylic lens and the functional components described below.

The temperature dial is graduated in 5°F increments between 65° and 85° and is color-coded -- red for hot and blue for cold -- to facilitate adjustments. The dial actuates and varies the resistance of a wire-wound rheostat mounted directly mounted above it.

The circuit board electrical switch is mounted on the underside of the baseplate. Attached to and positioned by the control lever are wiper contacts which ride on the circuit board pads to provide the required electrical circuit connections. How these connections are made is illustrated in the electrical circuit diagram on page 1-40.

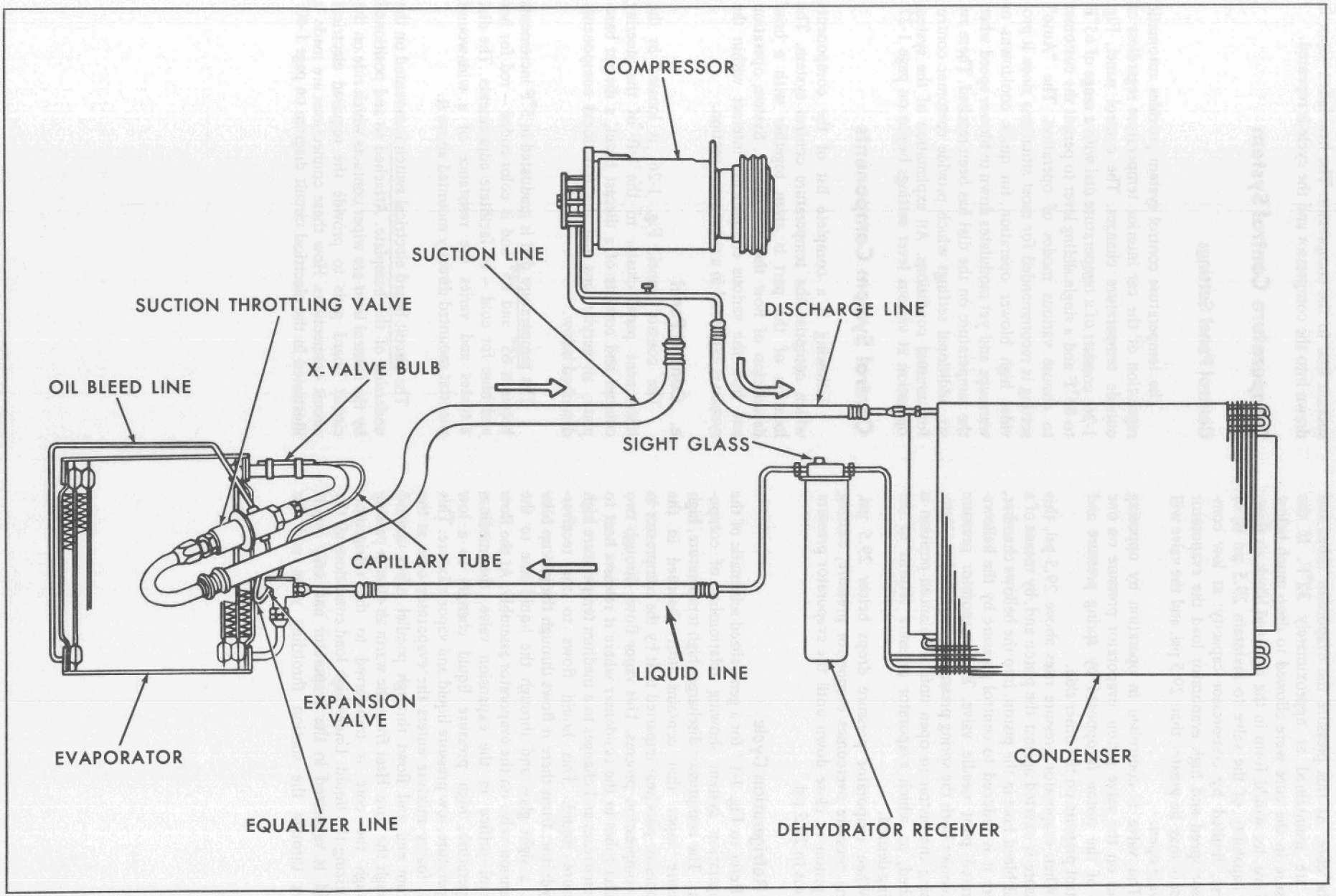


Fig. 1-17 Refrigeration Circuit

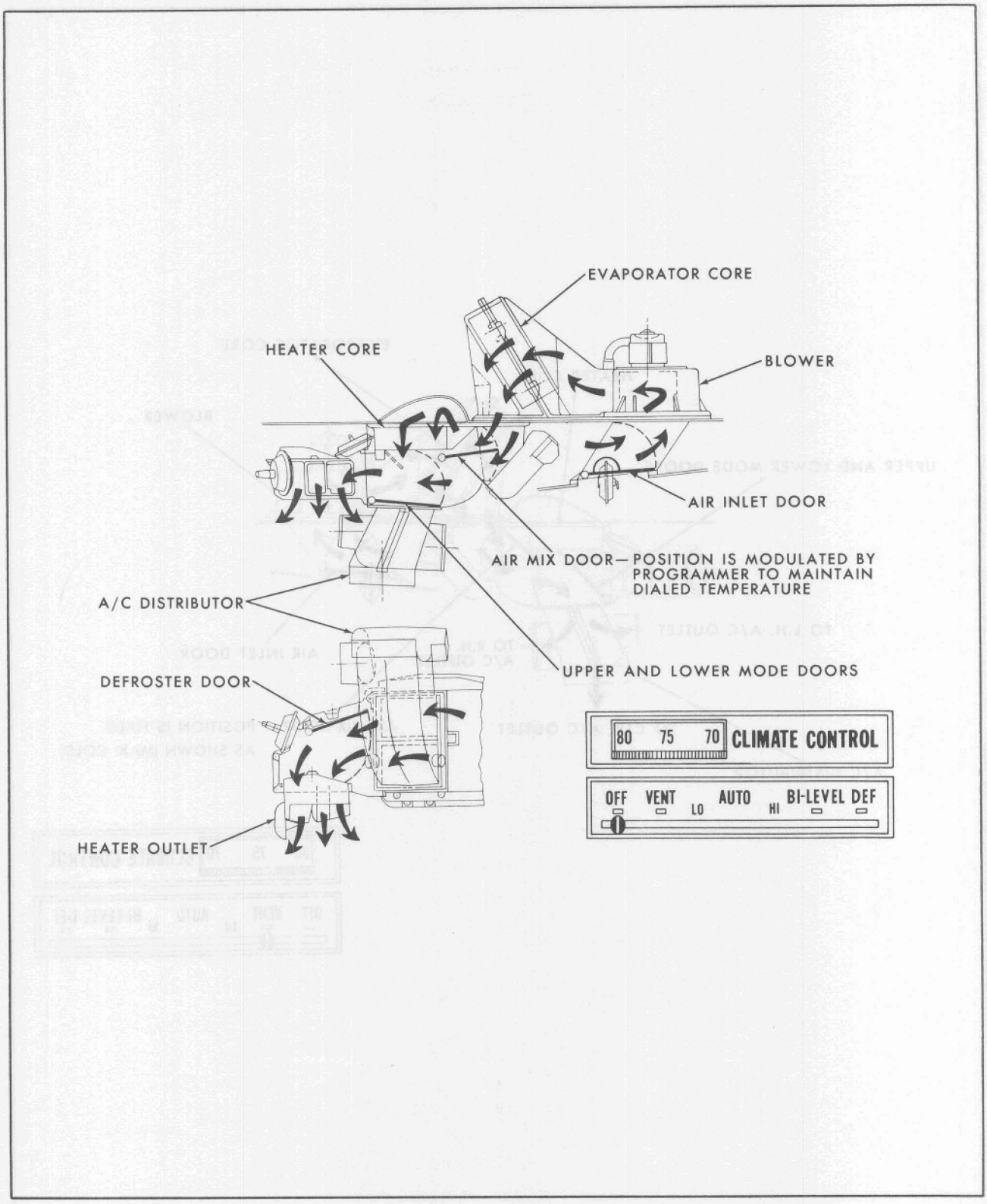


Fig. 1-18 Air Flow At "OFF" Setting

OFF - Outside air is circulated at a fixed low blower speed through the evaporator and heater assembly and discharged into the passenger compartment from the heater outlet when the ignition switch is in the "Run" position if turn on requirements are met. The temperature of the air is modulated to maintain the temperature on the dial; the ability of the system to maintain this temperature in warm weather is restricted, however, since the compressor is disengaged at this setting.

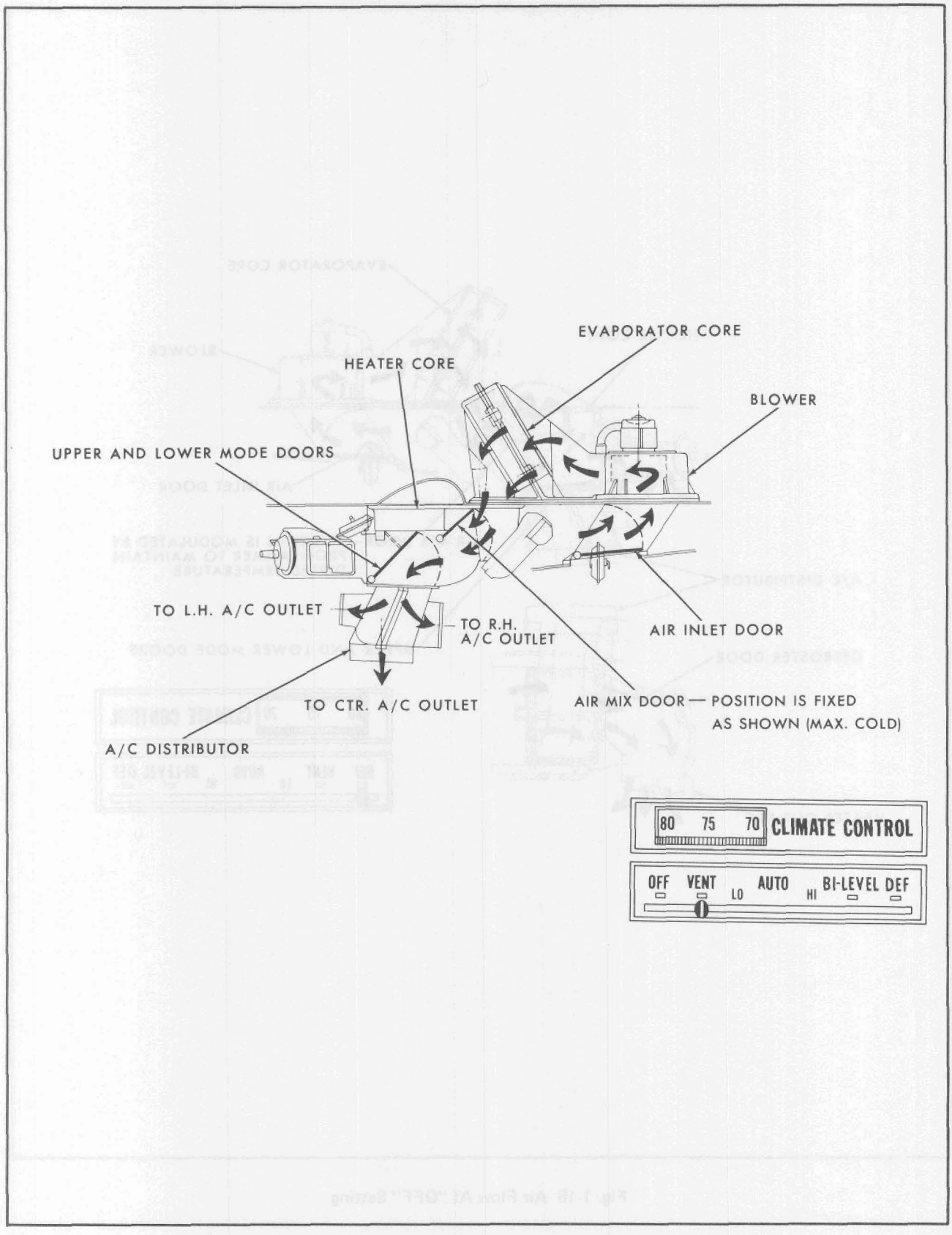


Fig. 1-19 Air Flow At "VENT" Setting

VENT - Unheated, uncooled outside air is delivered from the air conditioner outlets at a fixed low blower speed. The compressor is inoperative and the heater water valve is closed. There is no delay for engine water warm up.

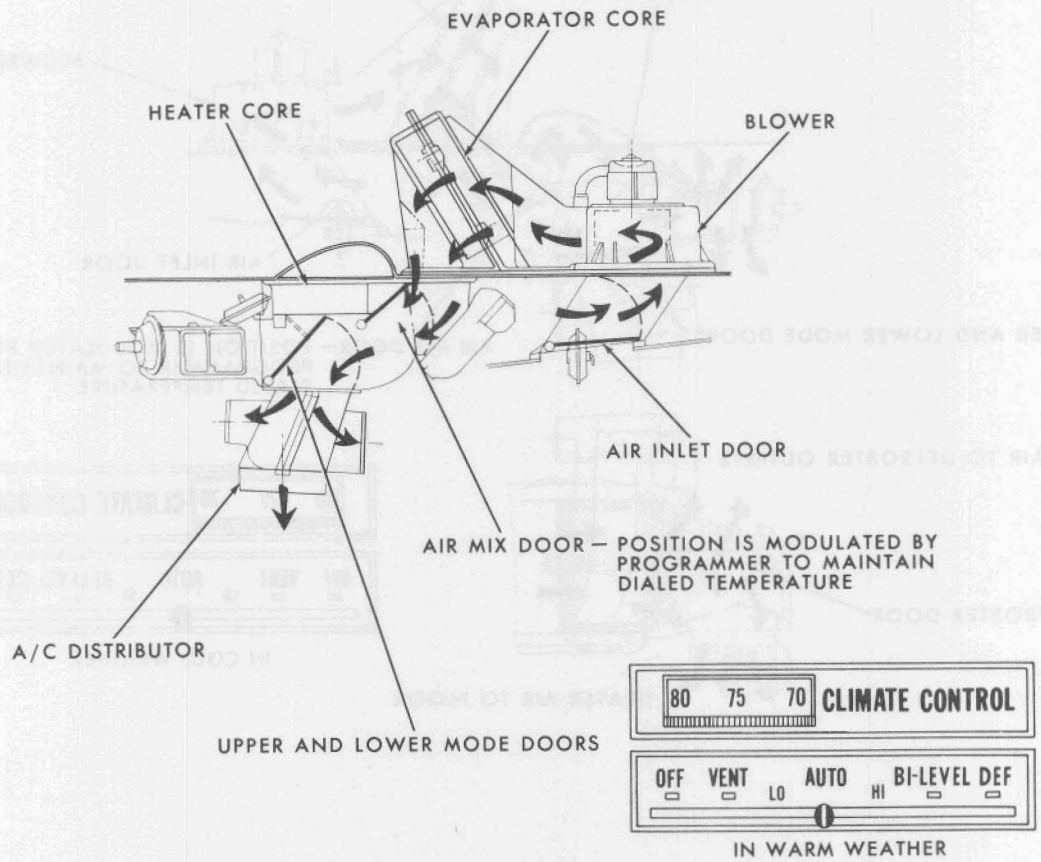


Fig. 1-20 Air Flow At "AUTO"-Warm Weather

LO - Operation at this setting is identical to that provided at "Auto" (see page 1-30), except that the blower operates at a fixed low speed.

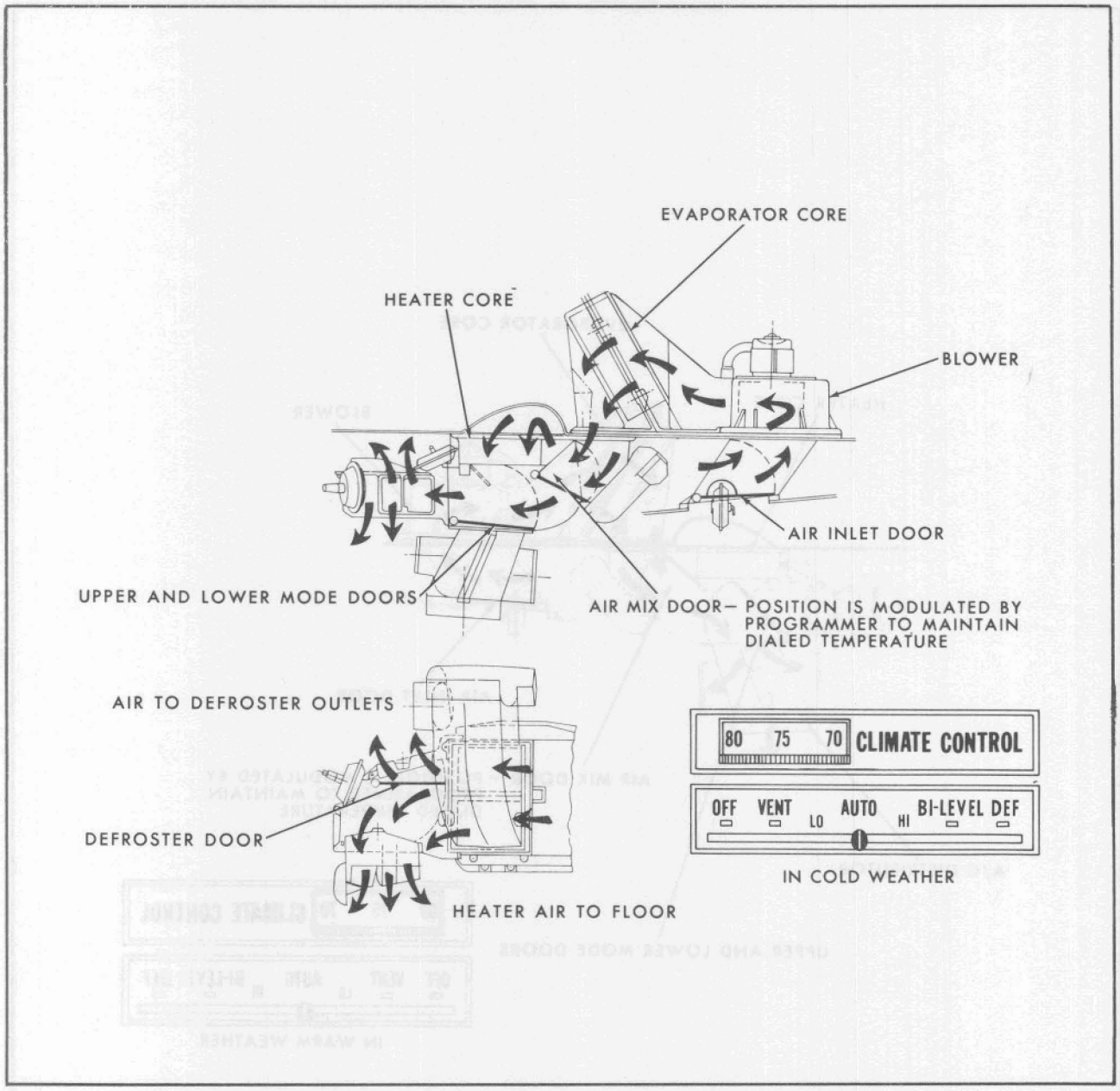


Fig. 1-21 Air Flow At "AUTO"-Cold Weather

AUTO - Regulation of blower speed, discharge air temperature, air delivery mode, system turn-on and compressor operation is accomplished automatically to maintain the temperature on the dial and to provide comfort.

Four blower speeds, HI, MED_3, MED_2, and MED_1 are utilized. If the car interior is significantly hotter or colder than the temperature on the dial, the blower will start at high and then sequence down to lower speeds as the dial temperature is approached.

Discharge air temperature will be varied automatically between approximately 45° and 150°. If the discharge air temperature is above approximately 90°, the air will be delivered from the heater outlet (Fig. 1-21); below approximately 75° it will be delivered from air conditioner outlets. Between these temperatures, air is provided from both the heater and air conditioner outlets (Bi-Level operation).

If the car interior is above approximately 75°, the system will turn on immediately when the car is operated. If the car is below 75°, system turn-on will be delayed, if the engine is cold, until engine water reaches approximately 120°.

Compressor operation is provided at all ambient temperatures above approximately 32°F even when not required for cooling, to assure maximum dehumidification of the air.

Only outside air is utilized as air supply for the system.

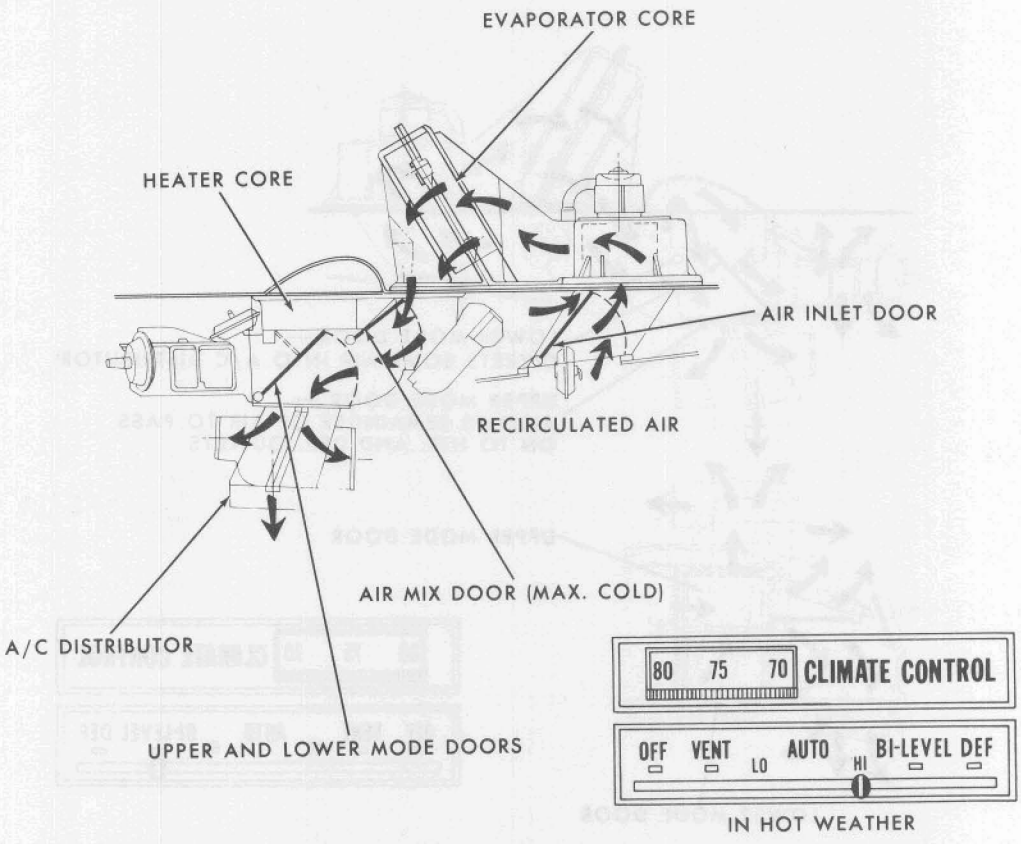


Fig. 1-22 Air Flow At "HI" Setting

HI - Operation at this setting is identical to that provided at "Auto" except that the blower operates at a fixed maximum speed and recirculated air is used when maximum cooling is required. This setting is provided for quickest possible cool down under extremely hot ambient conditions.

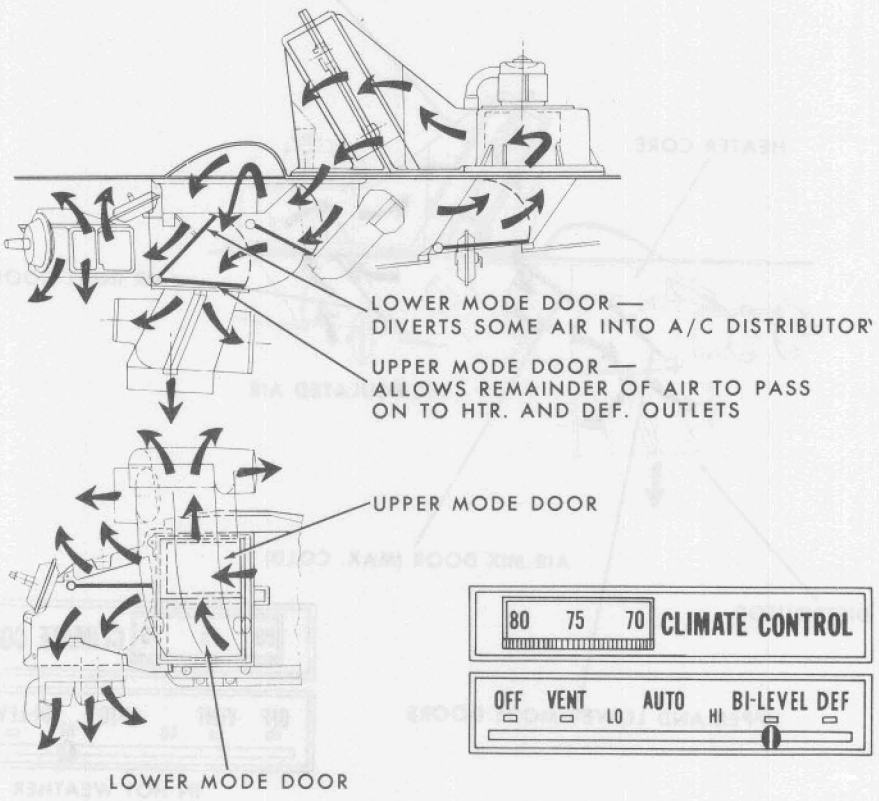


Fig. 1-23 Air Flow At "BI-LEVEL" Setting

BI-LEVEL - Operation at this setting is the same as at "Auto" except bi-level air delivery is provided -- approximately half the air is delivered from the heater outlet and the other half is discharged from the air conditioner outlets. This provides a pleasant, draft-free mode of operation in mild weather; it also permits defrosting of the side windows by the air streams from the end air conditioner outlets in cold weather.

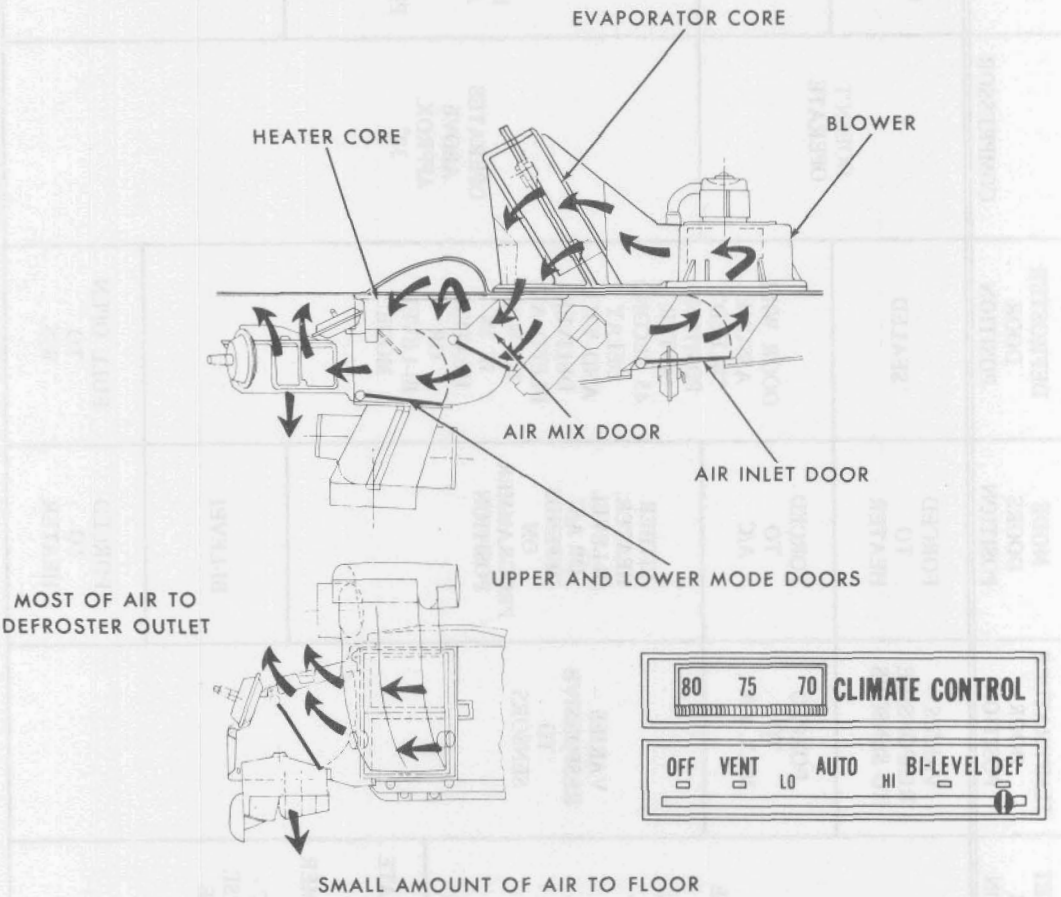


Fig. 1-24 Air Flow At "DEF" Setting

DEF - At this setting all the air is delivered to the windshield and the blower operates at a fixed high speed. Temperature regulation is maintained. Blower turn-on is immediate, even with a cold engine.

How the system operates at the various lever settings is depicted in organized fashion in the chart in Fig. 1-25.

SYSTEM RESPONSE

CONTROL LEVER SETTINGS	BLOWER SPEED	AIR INLET DOOR POSITION	TEMPERATURE DOOR POSITION	MODE DOORS POSITION	DEFROSTER DOOR POSITION	COMPRESSOR	HTR-WATER SHUT-OFF VALVE	IS BLOWER DELAYED FOR ENGINE WATER WARMUP?
OFF	FIXED LOW	OUTSIDE AIR	VARIES – RESPONSIVE TO SENSORS	FORCED TO HEATER	SEALED	DOESN'T OPERATE	USUALLY OPEN – EXC. CLOSED AT MAX. A/C	YES*
VENT	5.0V – HTR 4.5V – A/C		FORCED TO MAX. A/C	FORCED TO A/C	DOOR WILL ASSUME "BLEED" POSITION AFTER 45 SECOND DELAY AND WILL DELIVER BLEED AIR TO W/S IF IN HEATER OR BI-LEVEL MODE		CLOSED	NO – BLOWER IS TURNED ON BY O'RIDE SW.
LO			VARIES – RESPONSIVE TO SENSORS	EITHER HEATER, BI-LEVEL OR A/C DEPENDS ON PROGRAMMER POSITION		OPERATES ABOVE APPROX. 32°	USUALLY OPEN – EXC. CLOSED AT MAX. A/C POSITION OF PROGRAMMER	YES*
AUTO.	VARIABLE BLOWER PROGRAM							
HI	FIXED HI - 13.5 V	RECIRCULATE AIR WHEN PROGRAMMER IS AT MAX. A/C - OTHERWISE OUTSIDE AIR						
BI-LEVEL	VARIABLE BLOWER PROGRAM			BI-LEVEL			OPEN	
DEF	FIXED HI - 13.5 V			FORCED TO HEATER	FULL OPEN TO W/S			NO – BLOWER IS TURNED ON BY O'RIDE SW.

*EXCEPT WHEN CAR INTERIOR IS WARM, IN WHICH CASE A SWITCH ON THE CONTROL HEAD TURNS BLOWER ON IMMEDIATELY, EVEN IF ENGINE IS COLD.

Fig. 1-25 System Operation At Various Lever Settings

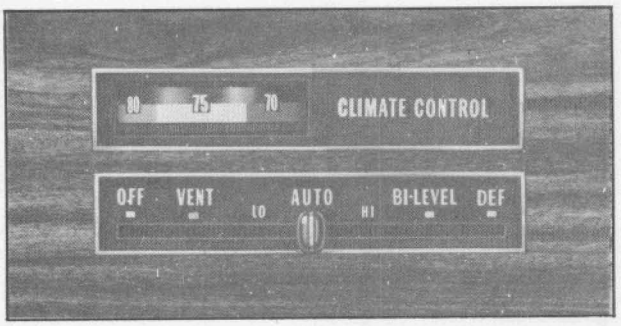


Fig. 1-26 Control Panel Face

Electrical wires from the switch and from the temperature dial rheostat are brought to a single ten-way connector.

The in-car turn-on switch (Fig. 1-30) is a thermostatic switch enclosed in a small plastic cylinder located just forward of the wire-retaining clip on the baseplate. It senses car interior temperature and will close and turn the system on if that temperature is above approximately 75°, even if engine water is cold and the other turn-on switch, located in the engine, is cold. This provides immediate cooling in a hot car that has not been run for some time.

The control vacuum valve, (Fig. 1-30) located at the forward edge of the baseplate, is a nine-port rotary valve which interconnects or vents the vacuum hoses attached to it to perform various vacuum functions required in the system. How the valve performs these functions is illustrated in the vacuum circuit diagram contained in a later section.

The control lens and the temperature dial are illuminated by a single bulb located on the right side of the control.

b. Sensors

Two sensors are used, one sensing outside air temperature and the other the car interior temperature. Both are disc-type thermistors approximately .30" in diameter and .060 thick. (A thermistor is a special resistor whose value changes markedly with temperature change -- it also differs from an ordinary resistor in that its resistance decreases as it gets hotter). The changes in resistance of these units forms the basic input to the control system.

The in-car sensor is located below the perforations on the top surface of the instrument panel cover, Fig. 1-27.

The ambient sensor is mounted on a flat phenolic board that attaches to the inlet case of the evaporator. See Fig. 1-28. Also mounted on this board is the compressor ambient switch; this switch is a bi-metal disc-type, snap-action thermostatic switch that disconnects the compressor below approximately 32°F ambient temperature. Both the sensor and the switch protrude into and sense the temperature of the air stream entering the evaporator core. Fig. 1-50 shows sensor characteristics.

c. Aspirator

To provide accurate sensing of the car interior temperature, a small amount of air is drawn into the in-car sensor housing and passed over the thermistor. See Fig. 1-29. This air movement is accomplished by the use of an aspirator mounted on top of the heater assembly and a rubber hose that connects the in-car sensor housing to the aspirator. The aspirator is a tube-within-a-tube arrangement; air from the heater case is discharged out the main, outer tube -- this air stream causes a suction at the end of the inner tube so that air flows out it also. The aspirator is equipped with a shield to prevent its outlet end from being blocked.

d. Programmer

The programmer, which contains the bulk of the temperature control components, is located in the passenger compartment on the right-hand end of the heater case. See Fig. 1-9 and 1-31. It is secured to the heater with three screws. It consists of a zinc die-cast chassis, an easily removable plastic cover and the functional components described below.

The amplifier, mounted to the chassis in the upper center area of the programmer, is a three-stage D-C amplifier that accepts a weak electrical signal from the sensors and the temperature dial and provides a strong output signal proportional to input. How the amplifier does this is explained on page 1-31. The amplifier should be serviced only as an assembly. No attempt should be made to repair an amplifier except by an experienced electronics technician with the proper service aids for calibration.

The transducer, located in the upper left corner of the assembly, consists of a vacuum regulating valve and solenoid coil. Output current from the amplifier flows through the solenoid coil and controls the vacuum output of the transducer. This component, in effect, transforms the electrical signal from the amplifier to an inversely proportional vacuum which is fed to the vacuum motor in another area of the programmer. More information on how this unit works is given on page 1-31.

The vacuum checking relay is located in the upper right corner of the programmer. It provides two separate vacuum checking functions. See Fig. 1-32. In the upper part of the relay is a conventional rubber check valve which is opened by engine vacuum applied at port 5, allowing port 3, which supplies vacuum to the rotary vacuum valve on the programmer and the control head, to be evacuated. If engine vacuum drops because of acceleration or steep grades, the check valve closes, maintaining the vacuum level at port 3.

In the lower part of the relay is a spring-loaded diaphragm which blocks or passes regulated vacuum from the transducer which is connected at port 2 to the vacuum motor which is connected to port 1. When engine vacuum at port 5 is high, the diaphragm is pulled upward allowing regulated vacuum to pass to the vacuum motor. When engine vacuum drops, the diaphragm moves downward blocking passage and maintaining vacuum in the vacuum motor.

The vacuum motor, located in the lower right corner, produces all mechanical motion within the programmer. It positions the vacuum motor mechanism which actuates the rotary shaft which drives the air-mix door link. This same mechanism moves the blower circuit board wiper, the vacuum valve operating arm and

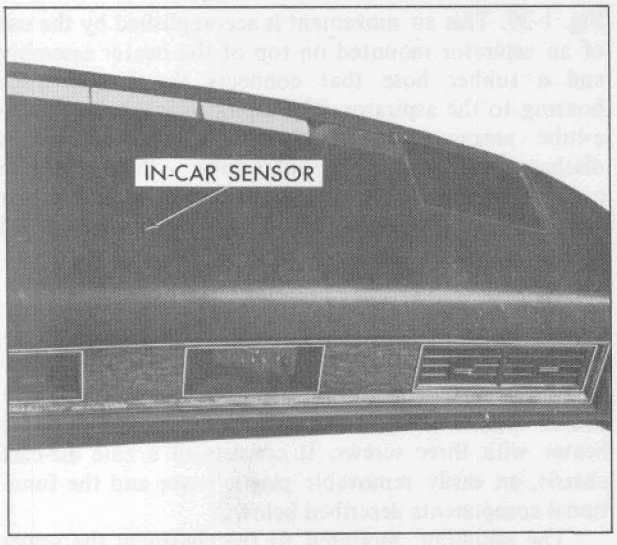


Fig. 1-27 In-Car Sensor

the feedback potentiometer. The vacuum motor mechanism is spring-loaded by a spring at its left-hand end so that with no vacuum it is fully extended out of the vacuum motor. This is the "Max A/C" position. When vacuum is applied to the vacuum motor, the mechanism is pulled into the vacuum motor -- approximately 8" of vacuum is required to pull the mechanism all the way to the "Max Heat" position.

The blower circuit board switch is located in the lower center part of the programmer. Spring-loaded contacts move across the board making the required blower circuit connections. The configuration of this switch is similar to that of the circuit board switch on the control head. Three resistors are attached to the underside of the circuit board and protrude through an opening in the heater case into the heater air stream which provides cooling for them. The function of the switch is to place these resistors into the blower circuit

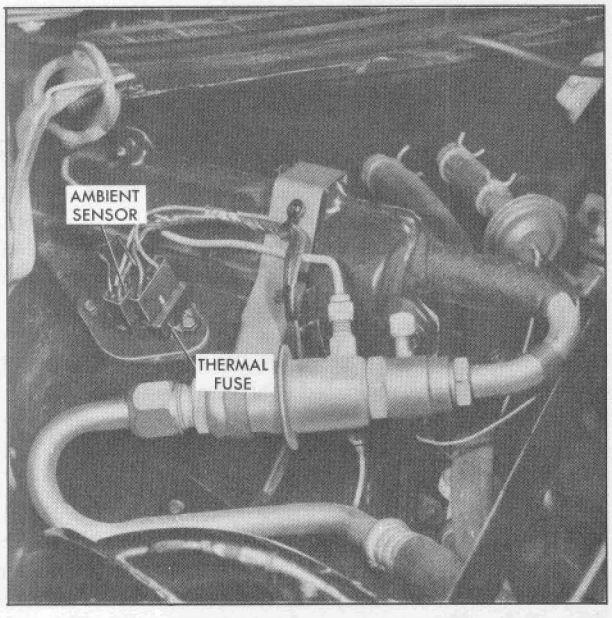


Fig. 1-28 Ambient Sensor and Switch

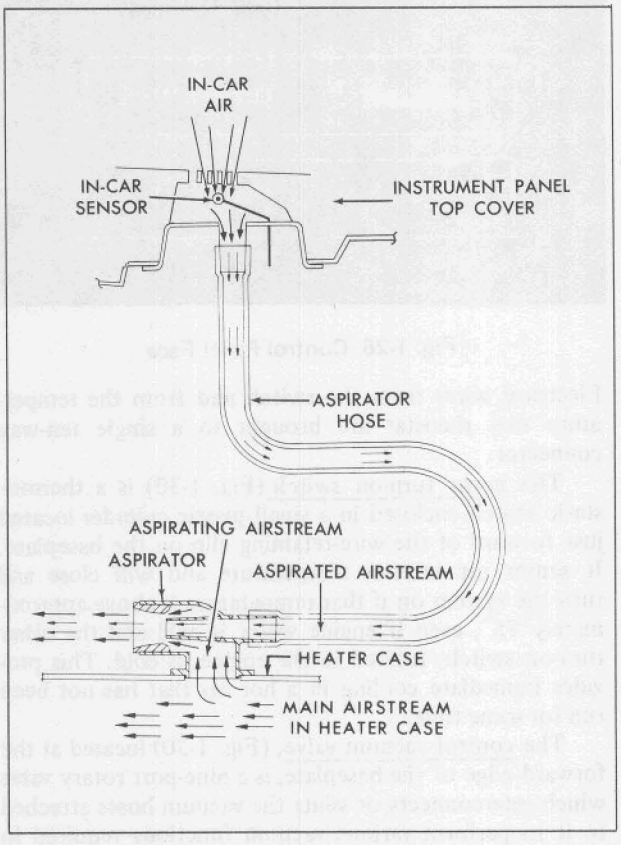


Fig. 1-29 In-Car Sensor Aspirator

at the required points in the program to control blower speed. A low blower resistor is also attached to the circuit board. Refer to the electrical circuit diagram contained on page 1-58 for a better understanding of this switch.

The vacuum valve, located in the center of the assembly, is a nine-port rotary valve which makes connections between the various ports or vents them, as required, to move air doors, operate the heater water valve, etc. Refer to vacuum circuit on page 1-58 for additional information.

The feedback potentiometer is located just above the vacuum valve. Its function is to snub movement of the vacuum motor so that a small signal from the sensors does not drive the motor all the way, one way or the other. The feedback pot is located, electrically, in the sensor string circuit and operates in opposition to the sensors -- if a sensor drives the vacuum motor toward "Max Heat", for example, when the motor starts to move, it will rotate the potentiometer so that its resistance change tends to offset the resistance change of the sensor. This unit is adjustable -- follow instructions accompanying the ATC Tester carefully when adjusting it.

The sequence of events in the control program as the programmer moves from "Max A/C" to "Max Heat" is given below:

1. Possibility of recirculated air is terminated.
2. Blower speed drops from HI to M_3.
3. Heater water valve opens.
4. Air-mix door starts to move, blending in hot air.
5. Blower speed drops to M_2.

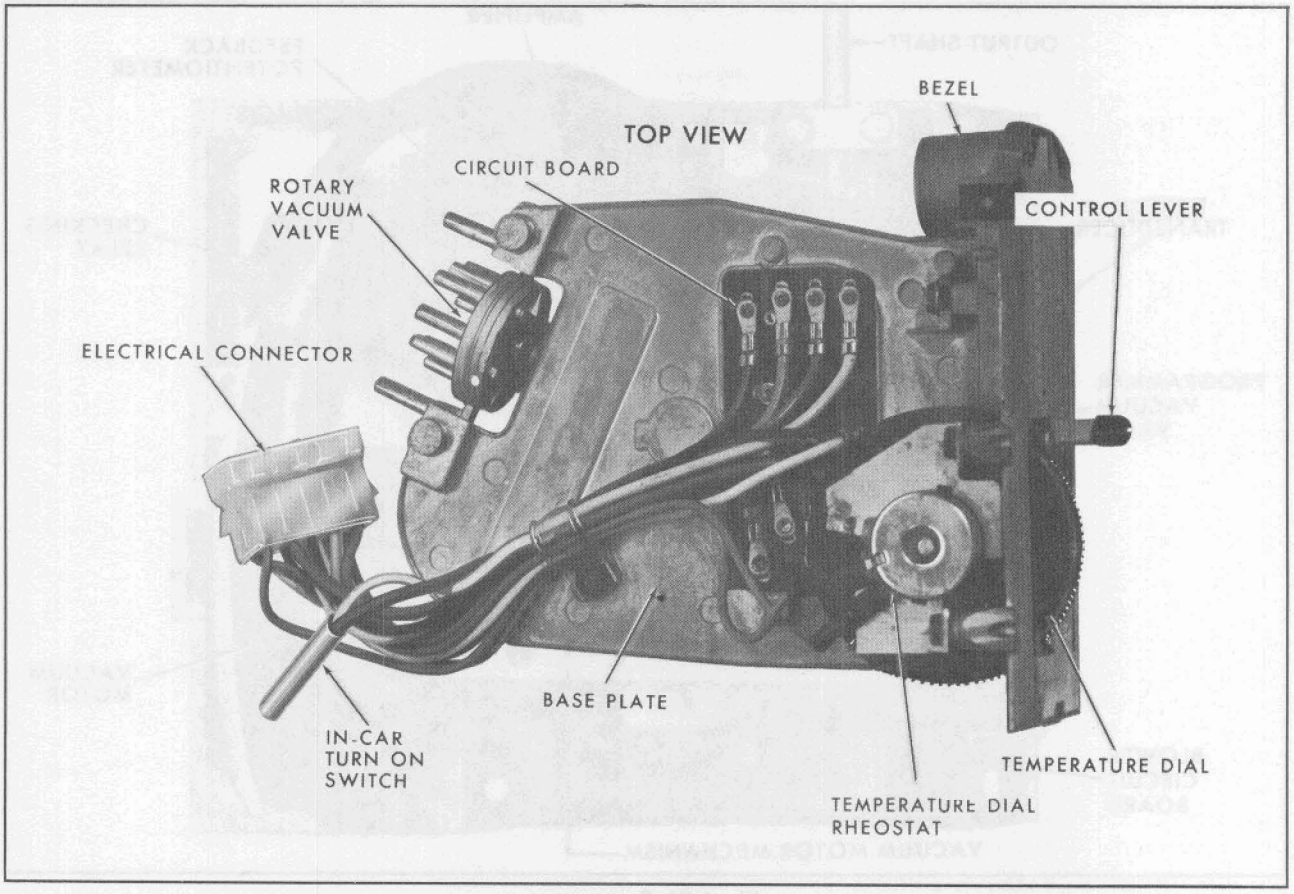


Fig. 1-30 Control Panel

6. Blower speed drops to M_1.
7. Mode of air delivery changes from A/C to heater.
8. Blower speed increases to M_2.
9. Air-mix door reaches "Max Heat" position.
10. Blower speed increases to M_3.
11. Blower speed increased to HI.

The sequence of events is reversed as the programmer moves from "Max Heat" to "Max A/C".

e. Air-Mix Door Link

The air-mix door link consists of a spring steel crank arm which slips down over the top of the output shaft of the programmer and a rod riveted to the crank arm. The other end of the rod attaches to the air-mix door crank arm and is retained to it with a clip. The spring steel crankarm is attached to the output shaft with a set screw which is tightened when the link is adjusted. The programmer positions the air-mix door by this link. See "Systems Adjustments" for adjustment procedure.

f. Blower Relays

Two single-pole, single throw relays are used to supply power to the blower. Both are located on the inboard side of the evaporator case in the engine compartment. See Fig. 1-33. The "Lo Relay" supplies power in the "Off", "Vent", and "Lo" positions of the control lever; the "Auto Relay" in the remainder of the positions. The two relays are identical and interchangeable.

g. Heater Turn-On Switch

This switch is a bi-metal, snap-action switch located in the front of the right-hand cylinder head, Fig. 1-34. It senses engine water temperature; it is closed above approximately 120°F and is open below that temperature.

h. Heater Water Valve

This valve is located in the engine compartment just to the left of the evaporator assembly. See Fig. 1-33. Its function is to pass or block flow of water to the heater. It is normally open but is closed by vacuum from the programmer vacuum valve when the programmer is positioned at "Max A/C".

i. Vacuum Hose Assembly

This assembly is mounted primarily on the heater inside the passenger compartment with connections to the programmer, the upper and lower mode door actuators and the defroster actuator, all of which are also a part of or mounted to the heater. See Fig. 1-9. A heavy branch of the hose assembly is routed to the control panel vacuum valve. Vacuum supply is obtained from a tee in a large vacuum hose (1/4 inch nominal) that comes from a fitting on the engine and penetrates the dash panel just forward and slightly to the left of the

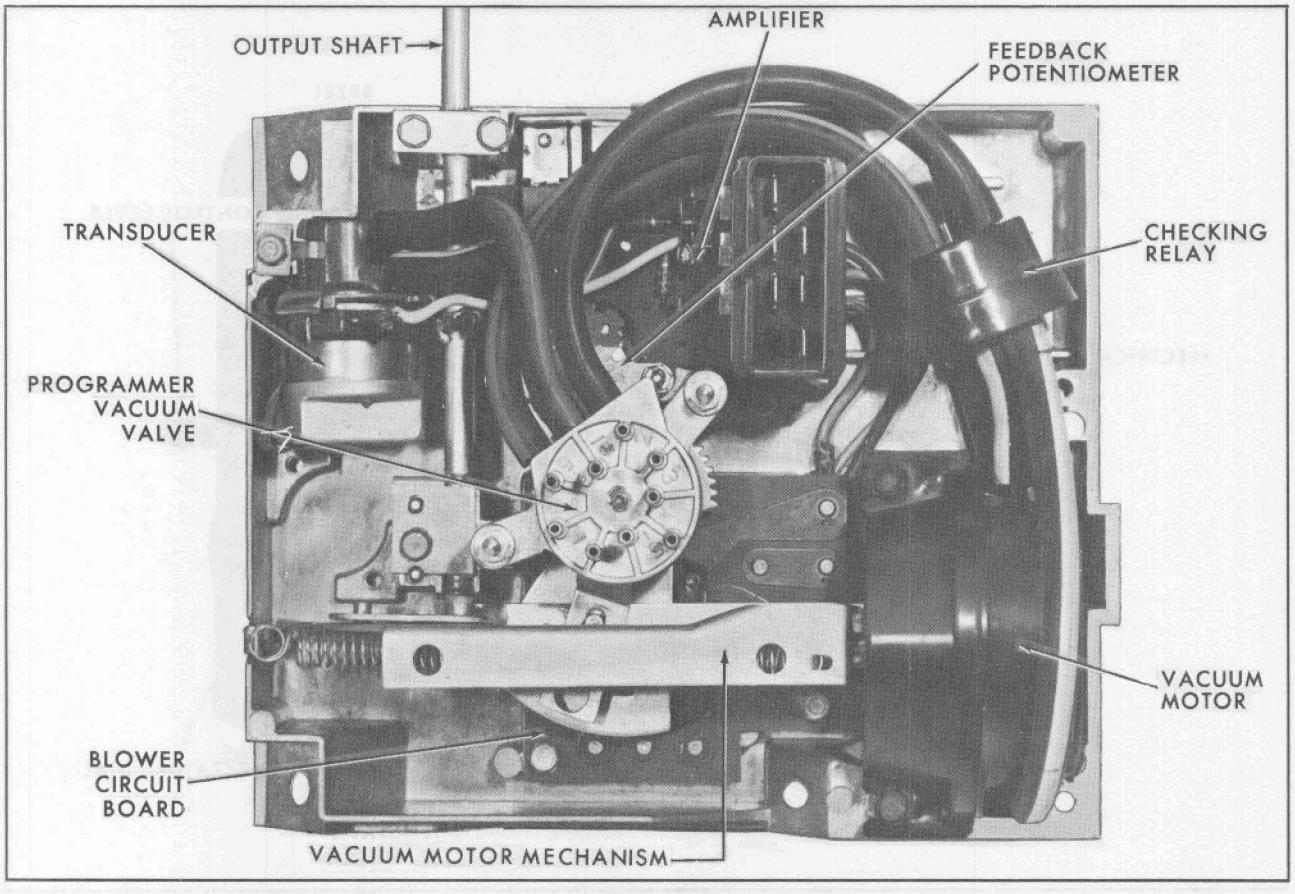


Fig. 1-31 Programmer

lower mode door actuator. The harness has two single hoses at its right-hand end which connect to the recirculating door actuator and to the heater water valve. The hose assembly is made of vinyl tubing with connector blocks at the programmer and control head which are retained with push-on washers. Hose retainers are alsc used at the two mode door actuators because of their inaccessibility.

A small porous vacuum delay plug is located in the end of the yellow hose that attaches to the outboard nipple of the defroster actuator. This plug provides a restriction to air flow and delays actuation of the defroster bleed function (approximately 45 seconds) after vacuum is supplied through the yellow hose. This delay is necessary to prevent sudden fogging of the windshield that can happen when the car is started under certain conditions. Do not remove this plug.

Another porous vacuum delay plug is located in the end of the orange vacuum hose that attaches to the recirc door actuator. This plug dampens movement of the recirc door to minimize cycling. The two plugs are not interchangeable.

Control System Operation

The automatic temperature control system is made up of three major sections which perform the following operations:

A. Temperature Control
B. Blower Control
C. Auxiliary Electrical and Vacuum Functions

The above sections will be described separately and in detail to aid system understanding and service diagnosis. Partial electrical and vacuum circuits are used to simplify operation explanation. Complete electrical and vacuum circuits are available on pages 1-58 and 1-59.

a. Temperature Control Circuit

This circuit is comprised of the following parts, described in the preceding section and shown in Fig. 1-35.

- Ambient Sensor
- In-Car Sensor
- Temp Dial

} Input to Programmer

- Feedback Pot
- Amplifier
- Transducer
- Vacuum Relay
- Vacuum Motor

} Programmer

The resistance of the two sensors varies with their temperature. Their resistance, plus that of the temperature dial, form the input (point 1 to point 3) to the programmer. This weak electrical signal, which varies with the temperature of the sensor or with temperature dial movements, is amplified by the amplifier to produce a relatively strong current flow through the transducer coil that varies in accord with input signal changes. The transducer converts this electrical signal to a proportional vacuum signal which is routed through the vacuum relay to the vacuum motor. The vacuum motor performs the following five output functions:

1. Positions the air-mix door
2. Positions the wiper on the blower circuit board switch

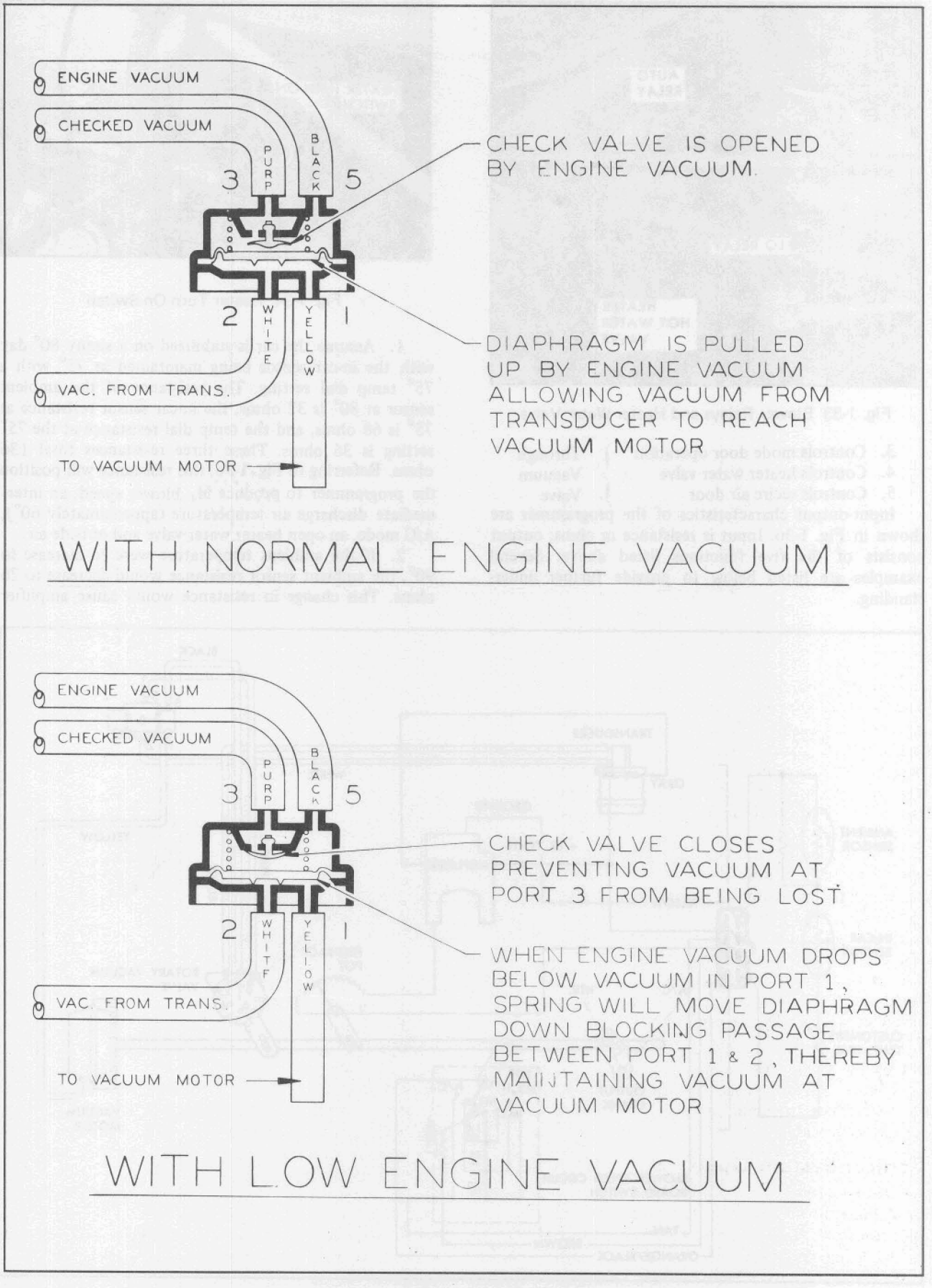


Fig. 1-32 Operation of Vacuum Checking Relay

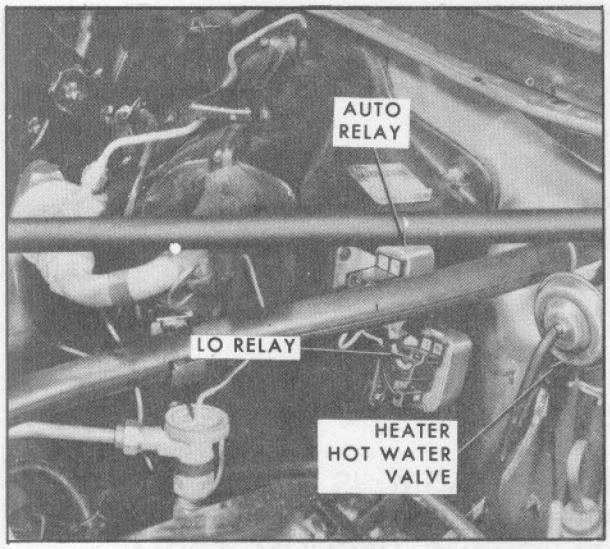


Fig. 1-33 Blower Relays and Heater Water Valve

3. Controls mode door operation } Through
4. Controls heater water valve } Vacuum
5. Controls recirc air door } Valve

Input-output characteristics of the programmer are shown in Fig. 1-36. Input is resistance in ohms; output consists of the five functions listed above. Several examples are listed below to provide further understanding.

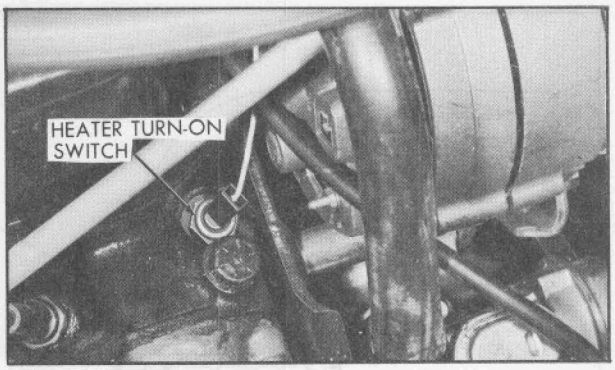


Fig. 1-34 Heater Turn-On Switch

1. Assume the car is stabilized on a sunny 80° day with the in-car sensor being maintained at 75° with a 75° temp dial setting. The resistance of the ambient sensor at 80° is 32 ohms, the in-car sensor resistance at 75° is 68 ohms, and the temp dial resistance at the 75° setting is 36 ohms. These three resistances total 136 ohms. Referring to Fig. 1-36, this resistance will position the programmer to produce M_1 blower speed, an intermediate discharge air temperature (approximately 60°), A/C mode, an open heater water valve and outside air.

2. If the ambient temperature were to increase to 90°, the ambient sensor resistance would decrease to 26 ohms. This change in resistance would cause amplifier

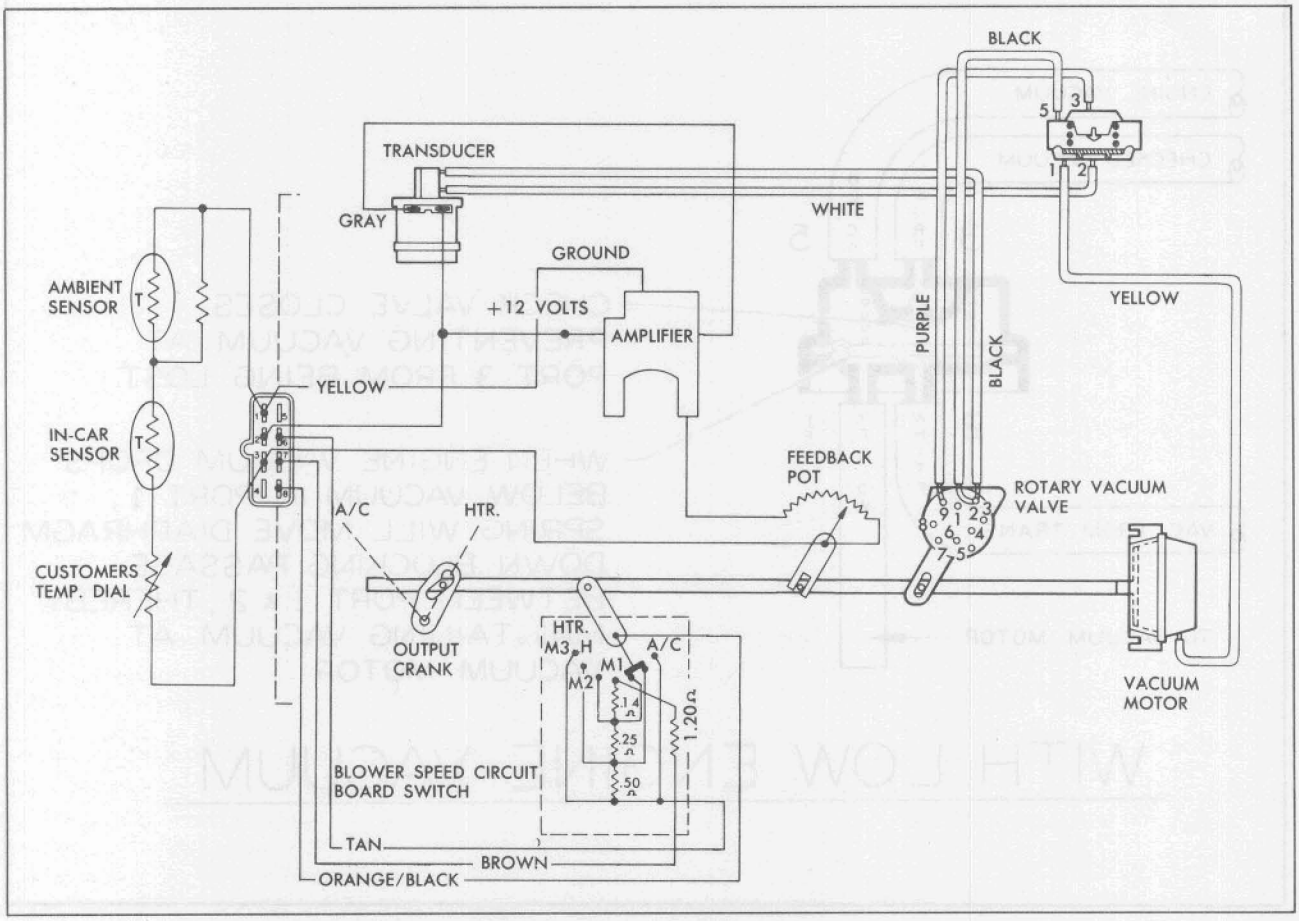


Fig. 1-35 Temperature Control Circuit

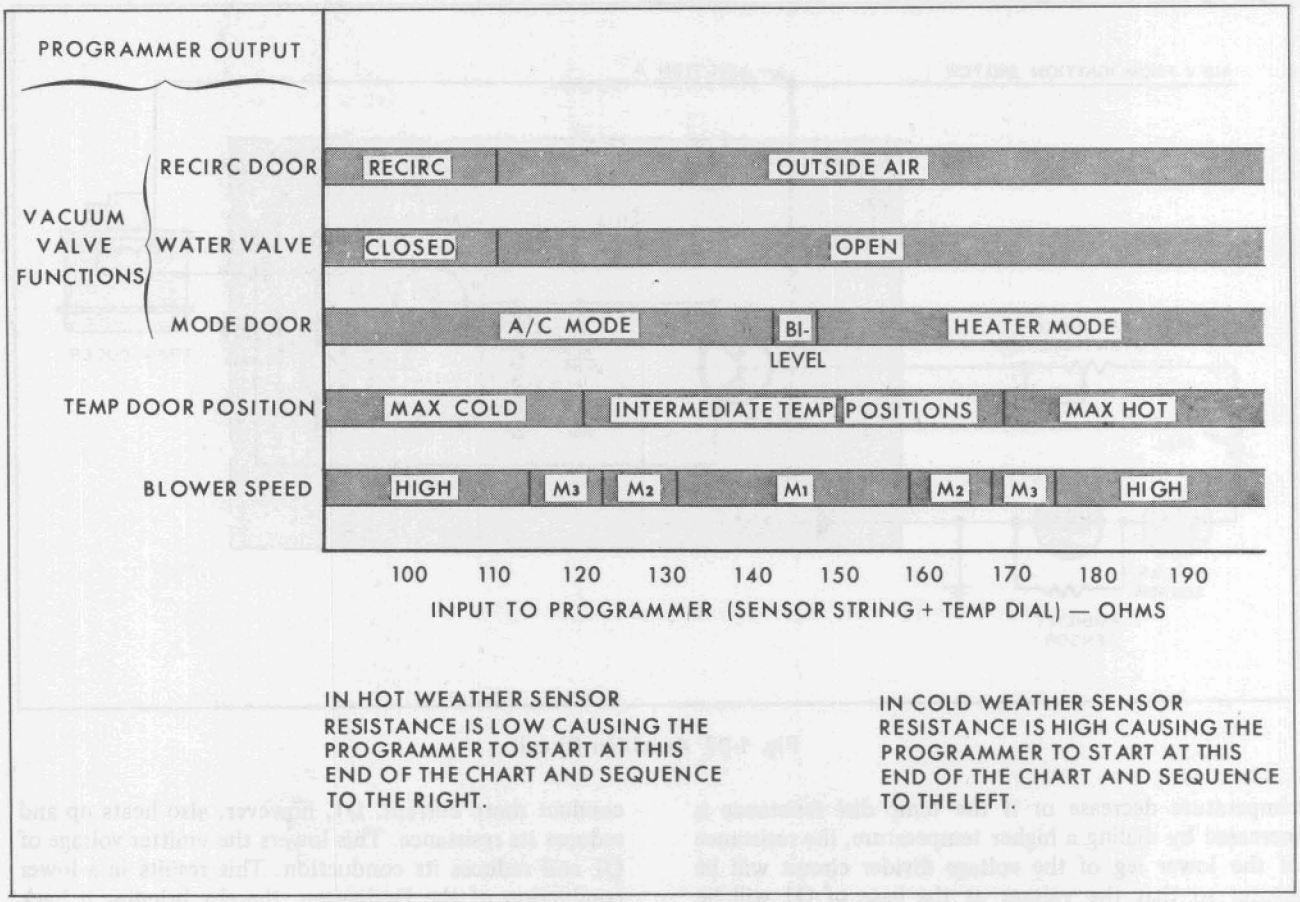


Fig. 1-36 Programmer Input-Output Chart

output current to increase which would cause the transducer output vacuum to the vacuum motor to decrease so that the new point of operation would be at the 130 ohm point in Fig. 1-36, producing M_2 blower speed and colder discharge air. The system would still be in A/C mode, with the water valve open, utilizing outside air. In this way, the in-car temperature is maintained at 75° despite the change in ambient temperature.

3. If heat load on the car were to be decreased, by driving under cloud cover, for example, the in-car sensor temperature would tend to decrease. This would cause its resistance to increase so that the total resistance to the programmer would increase. This would cause the programmer to move back to the right on the chart to a warmer position.

Note in the foregoing examples that an increase in amplifier output current cause a decrease in transducer output vacuum. Understanding this and similar relationships is important in problem diagnosis - for that reason they are listed below.

- Hot sensors result in low sensor string resistance which results in high amplifier output current which results in low transducer output vacuum which positions the vacuum motor in the cool or cold area of operation.
- Conversely, cold sensors operate at high resistance which results in low amplifier output which causes a high transducer vacuum which positions the vacuum motor in the warm or hot area of operation.

It is worth noting that an open sensor (disconnected, etc.) would represent a high resistance (as though the sensor were very cold) which would drive the programmer to maximum heat, while a shorted sensor would produce low resistance and drive the system to "Max A/C".

Amplifier and Transducer Operation

To complete the explanation of the temperature control circuit, a detailed description of amplifier and transducer operation is given below.

The amplifier circuit is shown in Fig. 1-37. The sensors, the temp dial and the feedback pot form the lower leg of a voltage divider circuit that runs from junction A to the base of Q1 to ground. The upper leg is R12. R13, R15 and D1 also form another voltage divider circuit from junction A to ground that results in a fixed voltage on the emitter of Q1. During stabilized operation of the system, the voltage difference between the base and emitter remains constant so that Q1 conducts a constant amount of current.

This current (electron flow) in Q1 actually flows from ground through the E-B diode of Q3, through the E-B diode of Q2 and through Q1. This current flow forward biases Q2 and Q3, the Darlington amplifier, and causes it to conduct. This results in a constant current flow through the transducer which produces a constant vacuum output.

If the resistance of a sensor increases as a result of a

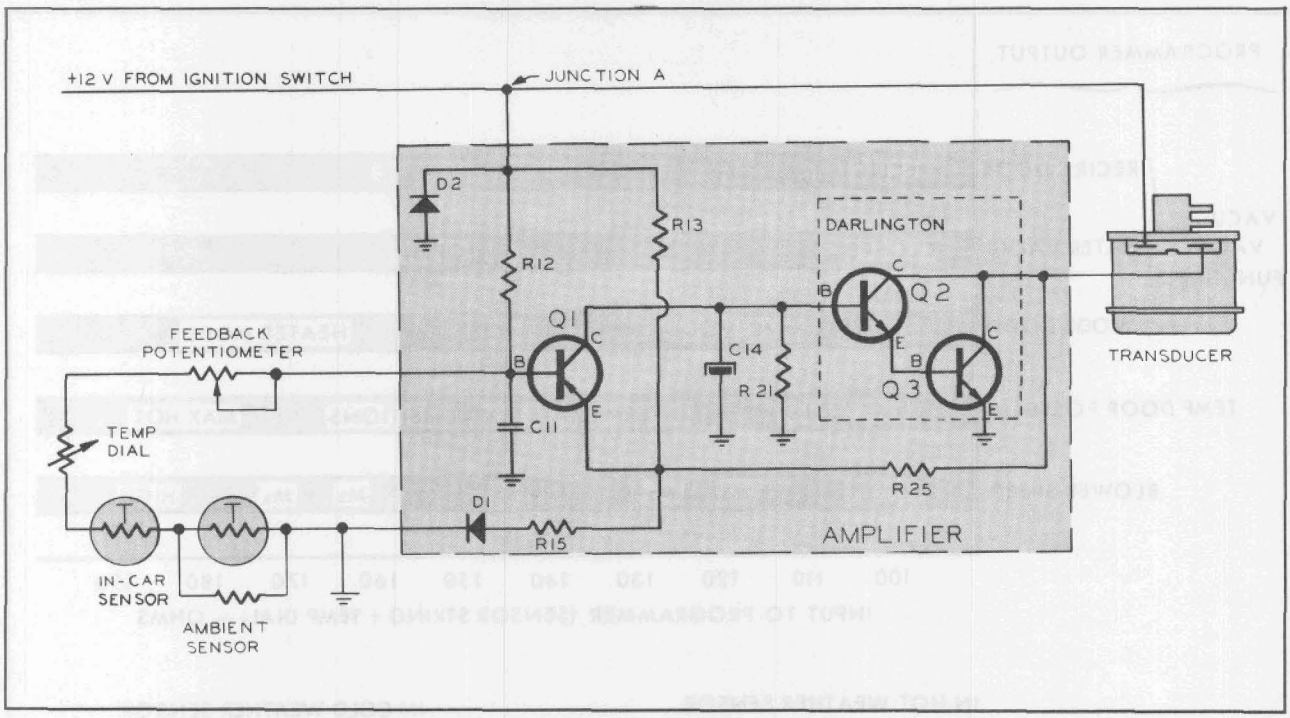


Fig. 1-37 Amplifier Circuit

temperature decrease or if the temp dial resistance is increased by dialing a higher temperature, the resistance of the lower leg of the voltage divider circuit will be greater so that the voltage at the base of Q1 will be greater. This reduces current flow through Q1 which in turn reduces the conduction of the Darlington amplifier so that transducer current decreases. This drop-off in transducer current produces a higher transducer output vacuum which drives the vacuum motor in the direction of "More Heat". As the vacuum motor moves, it rotates the feedback pot so that its resistance decreases. This produces a cancelling effect to the increased resistance which initially started the control activity. When the feedback pot completely offsets the initial resistance increase, the voltage at the base of Q1 is the same as it was earlier, and vacuum motor movement stops.

If the resistance of a sensor decreases or the temp dial is moved to a lower setting, the voltage at the base of Q1 will decrease. More current will now flow through Q3, Q2 and Q1. The increased current flow through Q1 causes the Darlington amplifier to conduct more transducer current. This results in lower transducer output vacuum which causes the vacuum motor to move toward "Max A/C". As the vacuum motor moves, the feedback pot increases in resistance, offsetting the original resistance decrease. The amplifier has now stabilized again and the movement stops.

Capacitor C11 at the base of Q1 filters out high-frequency AC signals which might cause erratic operation of the system. Capacitor C14 controls the reaction time of the amplifier and helps to stabilize its operation, eliminating oscillations. R25 is a feedback resistor that reduces the gain of the amplifier and produces more stable operation.

Diode D1 is located physically under the Darlington amplifier. When the Darlington heats up, it tries to conduct more current. D1, however, also heats up and reduces its resistance. This lowers the emitter voltage of Q1 and reduces its conduction. This results in a lower conduction of the Darlington, thereby bringing it back to its original conduction level. Diode D2 prevents voltage spikes from the input supply line from entering the amplifier.

The transducer, shown in Fig. 1-38, is actually a solenoid with a vacuum-regulating valve connected to the top end of the plunger located inside the windings. The plunger is positioned inside the windings depending on the amount of current flow passing through the windings from the amplifier. It is spring-loaded downward so that with no current flow, it is partially pulled out of the windings with the result that the pin at the top of the plunger is also pulled downward. This opens the port at seat A so that control vacuum is high, approaching raw vacuum level. When current flows through the windings, the plunger moves up into the coil so that the pin tends to seat at A and to become unseated at B. When it unseats at B, small amounts of air bleed in reducing the control vacuum level. With full current to the coil, the pin is fully seated and sealing at A and is fully open at B so that control vacuum is zero.

b. Blower Control Circuit

Three modes of blower speed control are available to the customer.

1. Fixed low blower speed
2. Four blower speeds automatically controlled by the programmer, ranging from M_1, which is slightly higher than the fixed low speed, through M_2 and M_3 to high.
3. Fixed high blower speed (approximately the same as the high in the automatic range).

Blower turn-on occurs in the following ways:

1. Delayed turn-on in cold weather until warm water is available from the engine.

2. Immediate turn-on in warm weather when the car interior is warm, regardless of engine water temperature.

3. Immediate turn-on regardless of temperatures, by owner override to the "Vent" or "Def" lever settings.

How turn-on and speed control are achieved at each of the seven lever settings is explained beginning on page 1-44.

c. Auxiliary Electrical and Vacuum Functions

The Compressor Clutch Circuit is shown in Fig. 1-46. When the ignition switch is closed, current flows through two pads on the control head which are inter-connected at all lever settings except "Off" and "Vent" and through the compressor ambient switch, which is closed above approximately 32°, to the compressor.

Auxiliary vacuum circuits are those which provide vacuum to operate the various air doors and the heater water valve. They do not include vacuum circuitry connected with the transducer and vacuum motor which functions independently and was explained in a previous section and shown in Fig. 1-35. The auxiliary vacuum circuits are best understood not by examining them all at one time in a complete circuit, but by tracing through each functional sub-circuit, as will be done beginning on page 1-52.

Complete Vacuum Circuit Diagram

A complete vacuum circuit diagram is shown in Fig. 1-53. Included are "clocks" which show the internal connections of the programmer and control head vacuum valves at various positions and settings.

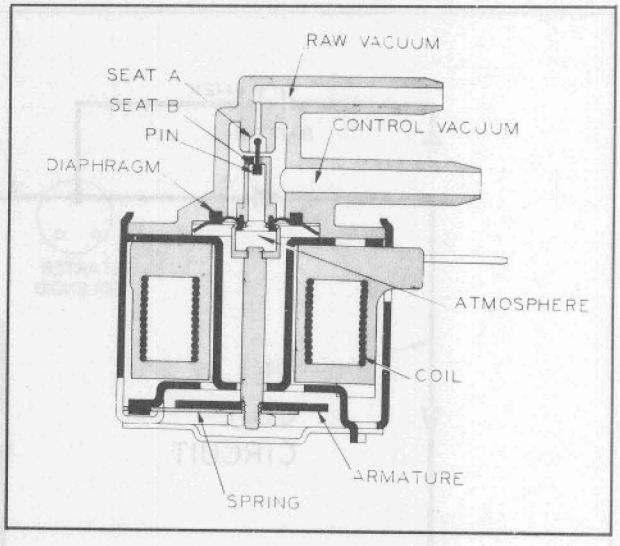


Fig. 1-38 Electromagnetic Transducer

Complete Electrical Circuit Diagrams

Fig. 1-46 shows a complete circuit diagram in a form to permit easy tracing of circuits. Fig. 1-54 is a wiring circuit diagram that shows actual wiring arrangements, such as connectors, bulkhead connectors, location of splices, etc. The two circuits are in agreement in everything except the form in which they are presented. If there is any question regarding correctness of connections, use Fig. 1-54.

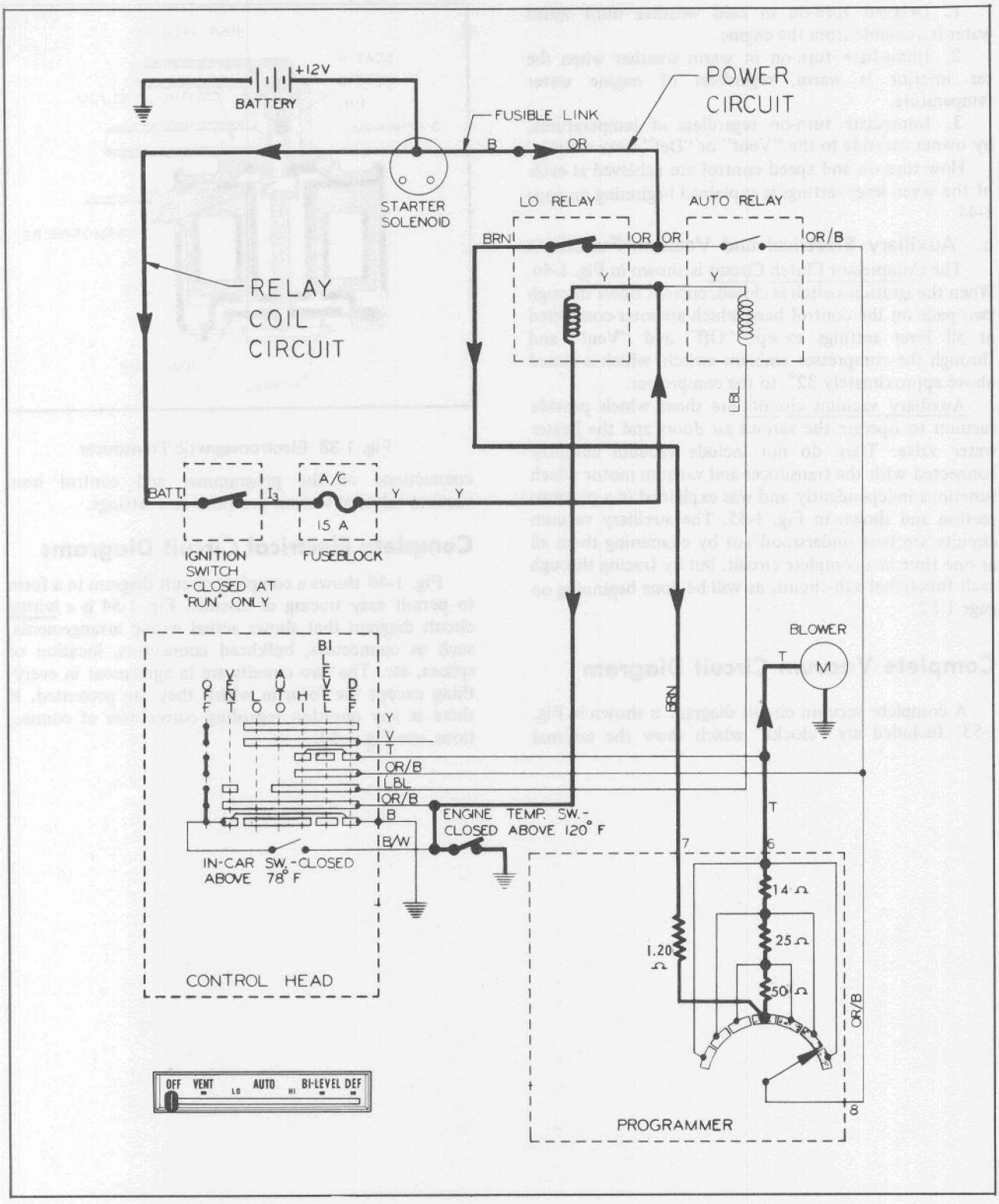


Fig. 1-39 Blower Operation At "Off"

Blower Operation at "Off" (Fig. 1-39)

When the ignition switch is closed, current flows through the "Relay Coil Circuit" to the "Lo Relay" and to ground through either the engine temperature switch or the in-car switch (in the illustration the engine switch is shown closed). In cold weather the relay could not be actuated until engine water is warm. Blower current flows through the "Power Circuit" to the "Lo Relay", through all four resistors in the programmer to the blower motor which operates at low speed. Movement of the programmer has no affect on blower speed.

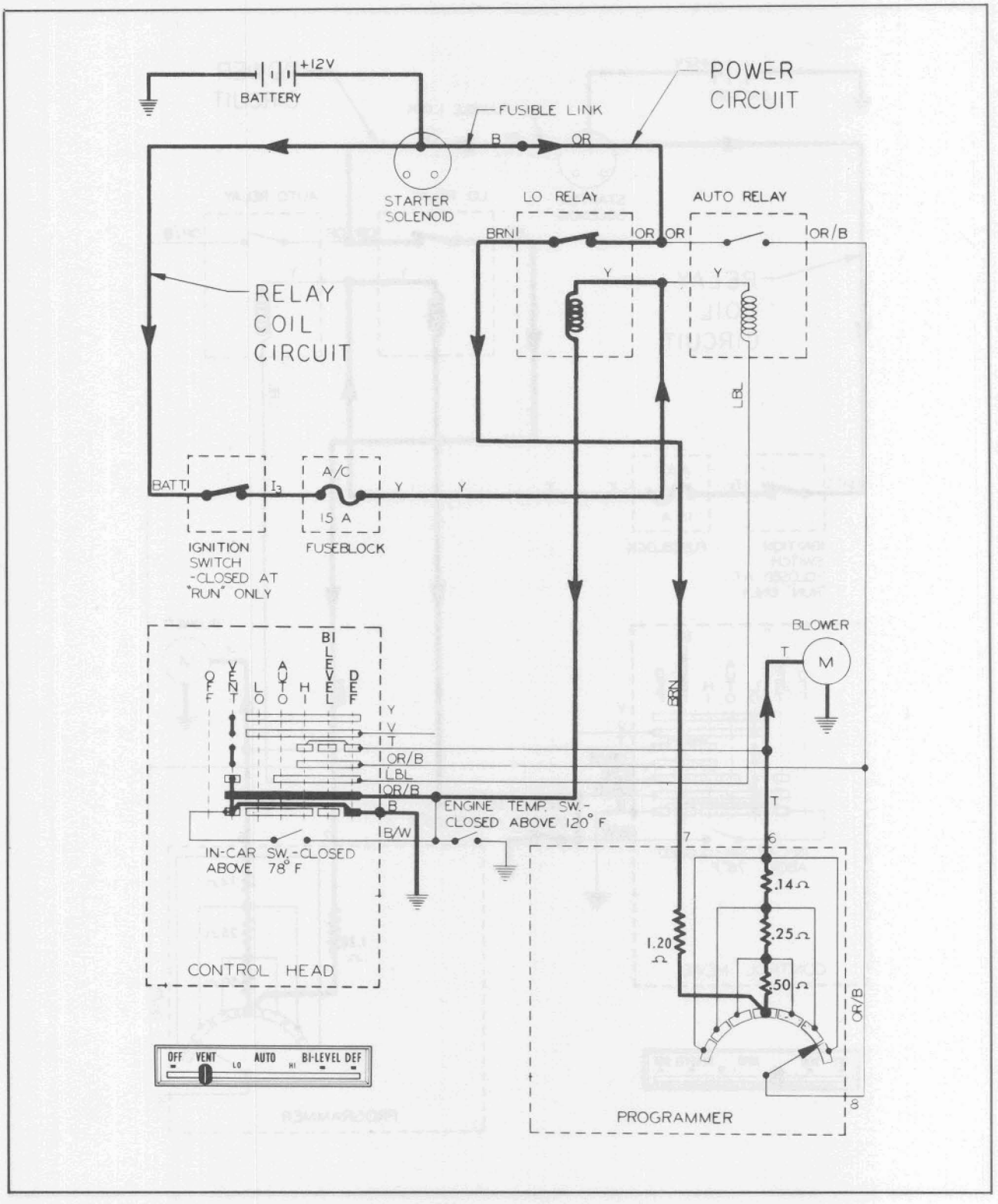


Fig. 1-40 Blower Operation At "Vent"

Blower Operation at "Vent" (Fig. 1-40)

Current flow is the same as at "Off" except that two pads on the control head circuit board switch are connected by the wiper so that current through the "Lo Relay" coil reaches ground regardless of whether the engine switch or the in-car switch are closed. This gives immediate blower turn-on. Since blower current must pass through all four resistors, the blower operates at fixed low speed.

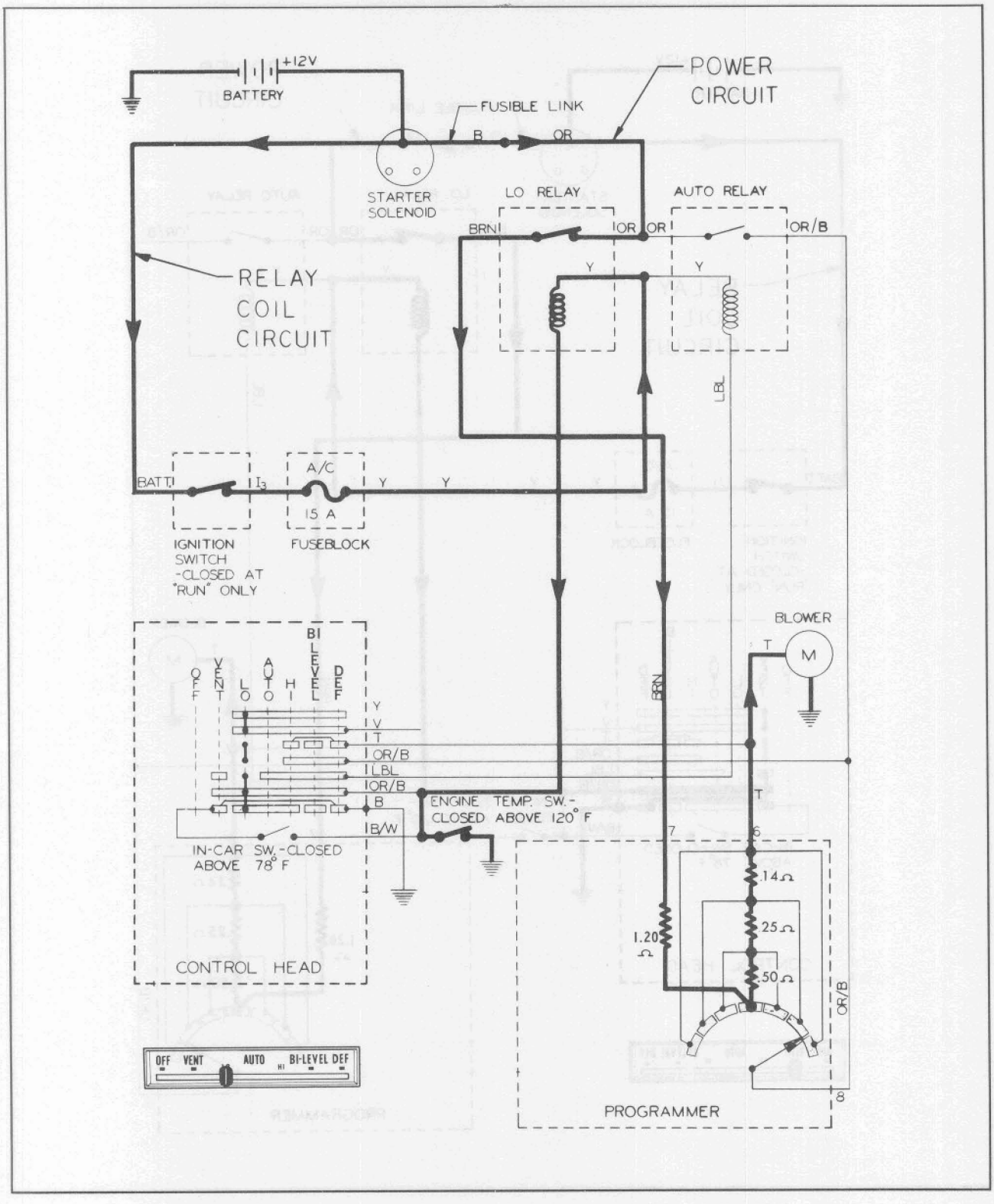


Fig. 1-41 Blower Operation At "Lo"

Blower Operation at "Lo" (Fig. 1-41)

Same as at "Off".

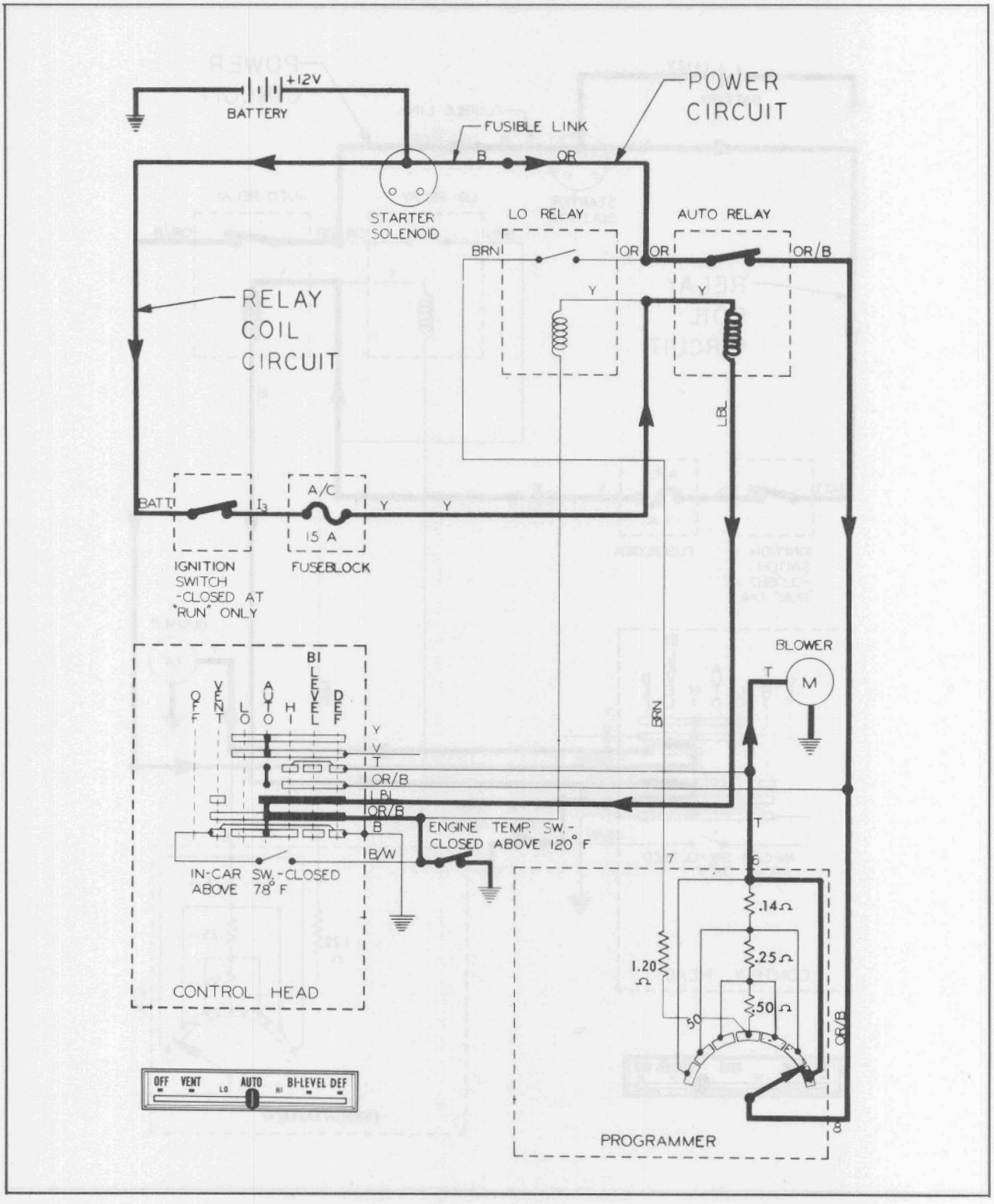


Fig. 1-42 Blower Operation At "Auto"

Blower Operation at "Auto" (Fig. 1-42)

Current flows through the relay coil circuit to the auto relay and to ground through either the engine temperature switch or the in-car switch. There is no grounding connection on the control head circuit board switch so that the blower will delay in cold weather. Blower current flows through the power circuit to the center point of the wiper on the programmer and through one, two or three resistors, depending on the position of the programmer, to the blower motor.

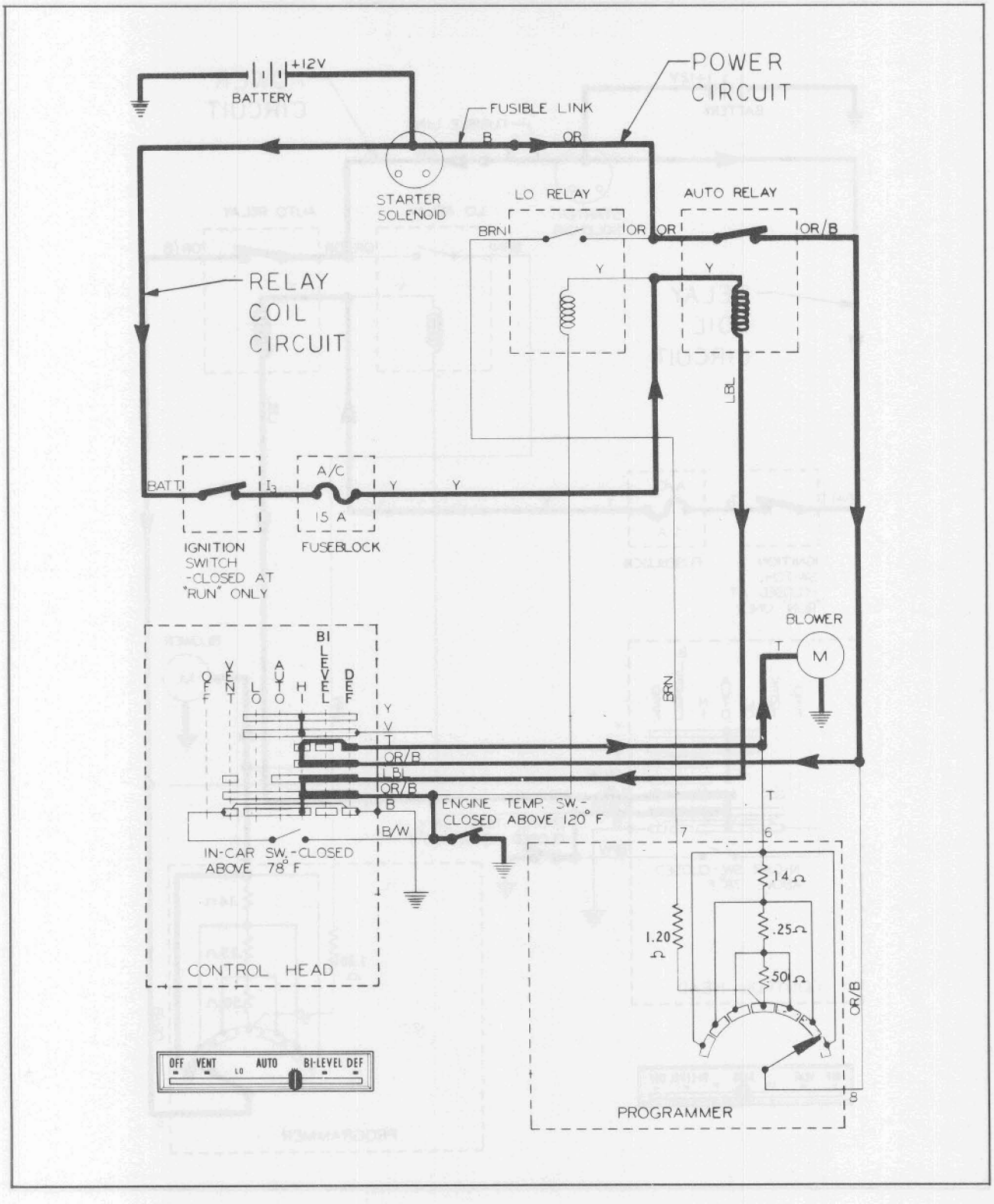


Fig. 1-43 Blower Operation At "Hi"

Blower Operation at "Hi" (Fig. 1-43)

Current flow through the relay coil circuit is the same as at "Auto". Blower current, however, does not go through the programmer but is routed through two inter-connected pads on the control head directly to the blower motor. There is no resistance in the circuit so that the blower operates at a fixed high speed, with no programmer control over its operation.

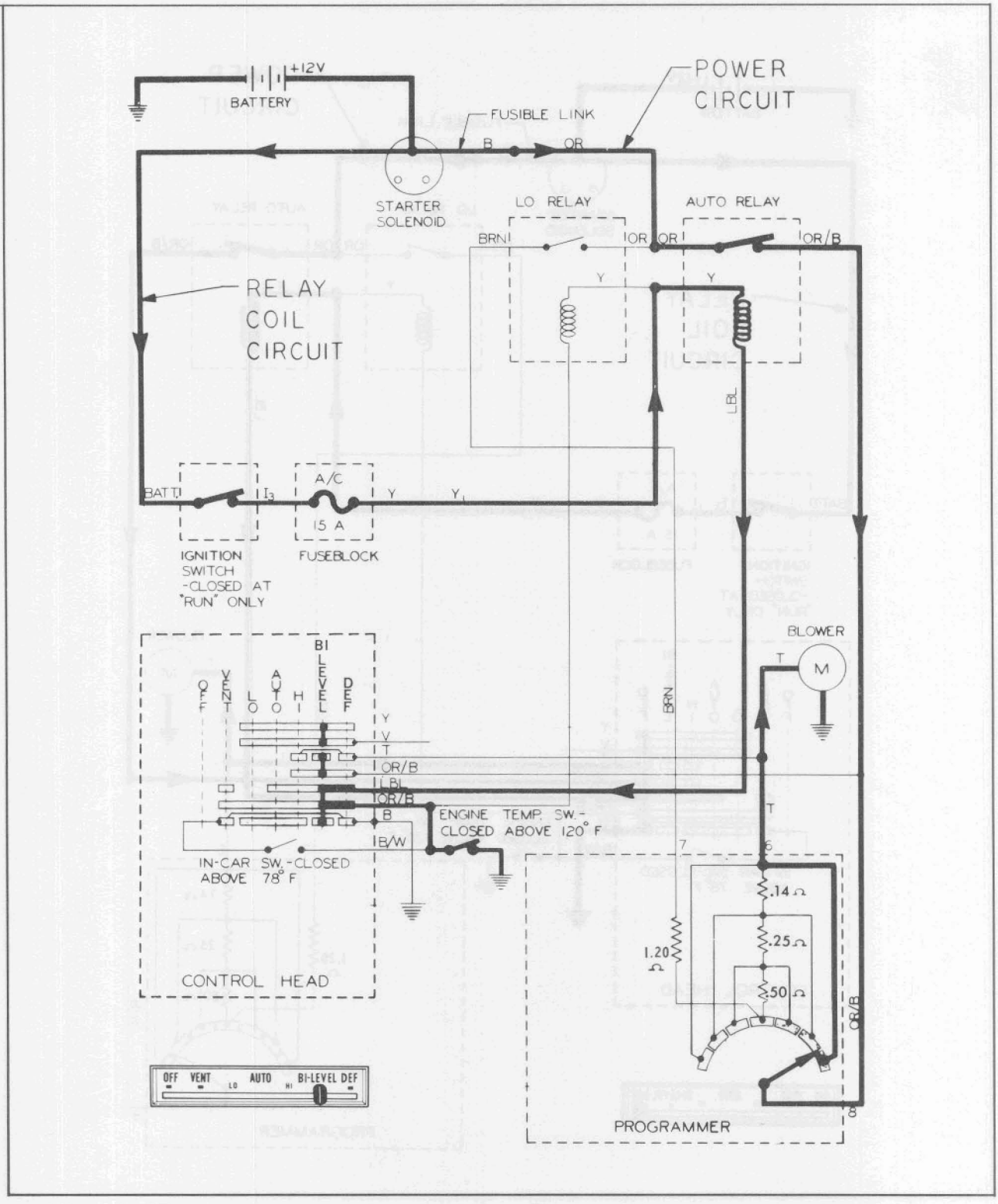


Fig. 1-44 Blower Operation At "Bi-Level"

Blower Operation at "Bi-Level" (Fig. 1-44)

Same as at "Auto".

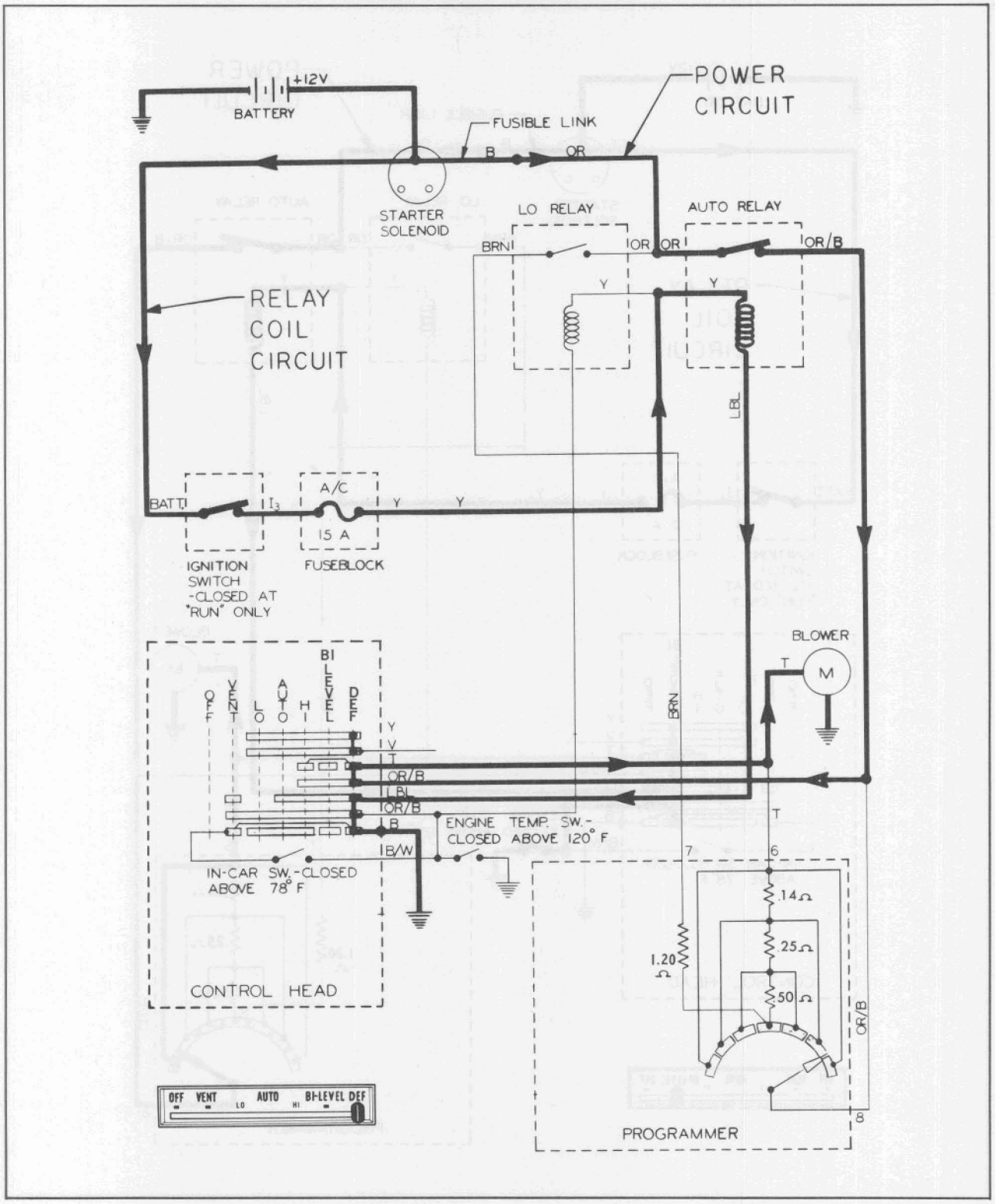


Fig. 1-45 Blower Operation At "Def"

Blower Operation at "Def" (Fig. 1-45)

The Auto Relay Coil is grounded through two pads on the control head so that there is immediate turn-on even with a cold engine. Blower current flows through the power circuit to two inter-connected pads on the control head and to the blower. The blower operates at a fixed high speed.

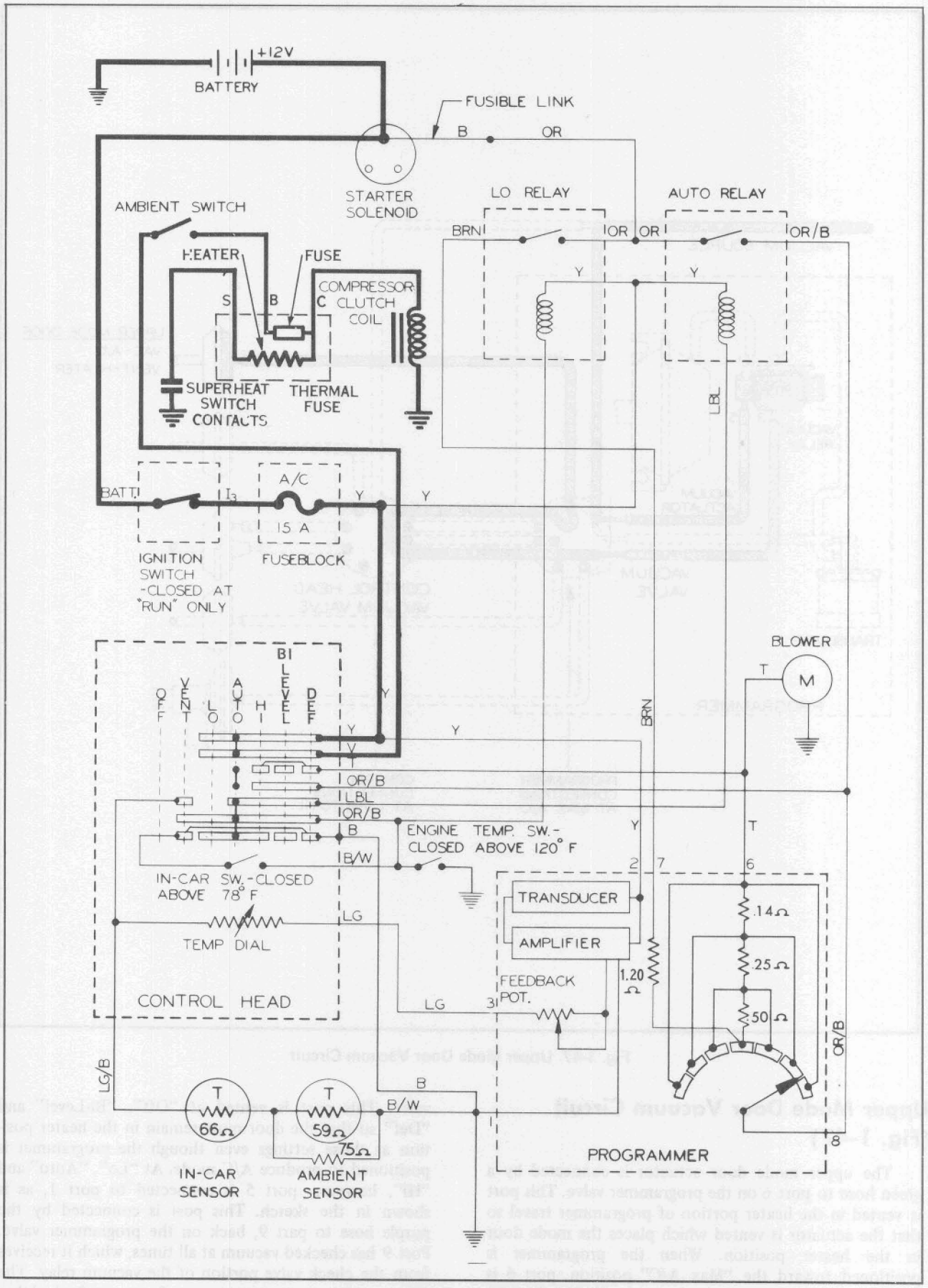


Fig. 1-46 Compressor Electrical Circuit

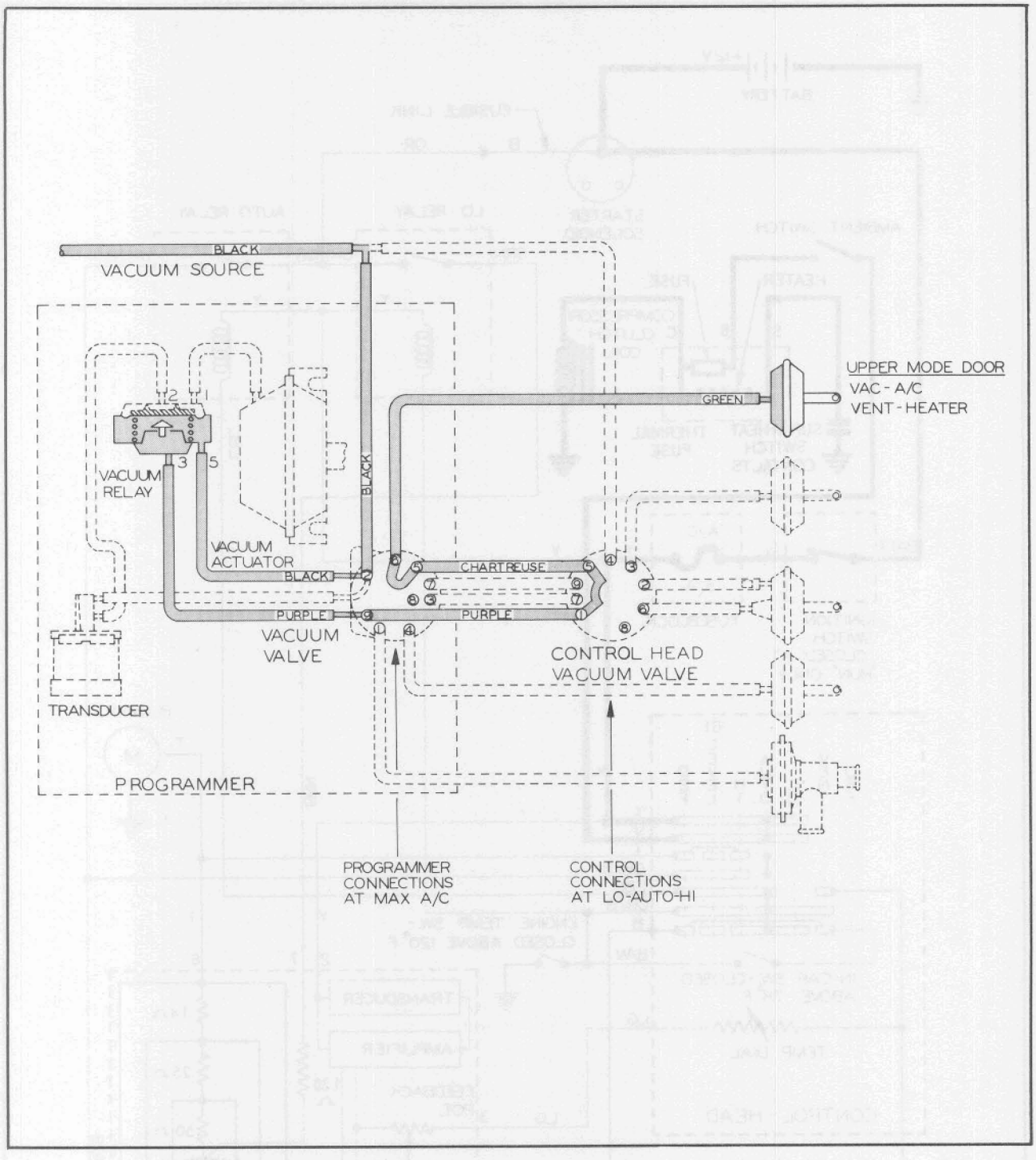


Fig. 1-47 Upper Mode Door Vacuum Circuit

Upper Mode Door Vacuum Circuit (Fig. 1-47)

The upper mode door actuator is connected by a green hose to port 6 on the programmer valve. This port is vented in the heater portion of programmer travel so that the actuator is vented which places the mode door in the heater position. When the programmer is positioned toward the "Max A/C" position, port 6 is connected to port 5, which is connected by the chartreuse hose to port 5 on the control head vacuum valve. This port is vented at "Off", "Bi-Level" and "Def" so that the door must remain in the heater position at those settings even though the programmer is positioned to produce A/C mode. At "Lo", "Auto" and "Hi", however, port 5 is connected to port 1, as is shown in the sketch. This port is connected by the purple hose to part 9, back on the programmer valve. Port 9 has checked vacuum at all times, which it receives from the check valve portion of the vacuum relay. The vacuum relay receives its vacuum from port 2 which has raw vacuum at all times.

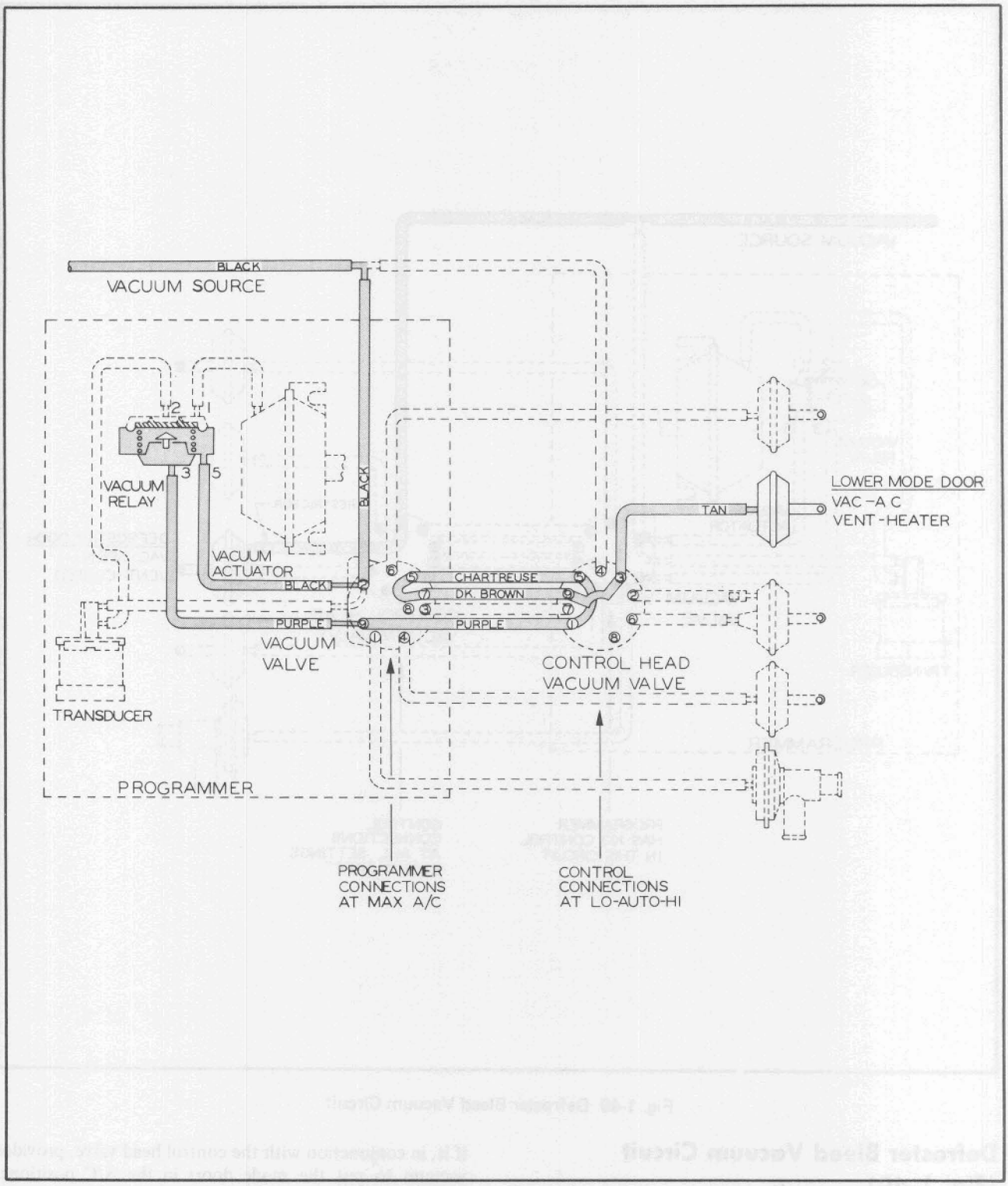


Fig. 1-48 Lower Mode Door Vacuum Circuit

Lower Mode Door Vacuum Circuit (Fig. 1-48)

The lower mode door actuator is connected by a tan hose to port 3 on the control head. Port connections in the control valve at "Lo", "Auto" and "Hi" are as shown in the sketch. At the programmer, port 5 is connected to port 7 in the A/C portion of programmer travel, as shown. Under these conditions, checked vacuum is fed to the actuator which positions the lower mode door in the A/C position. At "Off" and "Def", port 3 on the control head is vented forcing the door to heater mode. At "Bi-Level", port 3 is connected to port 1 on the control head, forcing the mode door to the A/C position regardless of the position of the programmer.

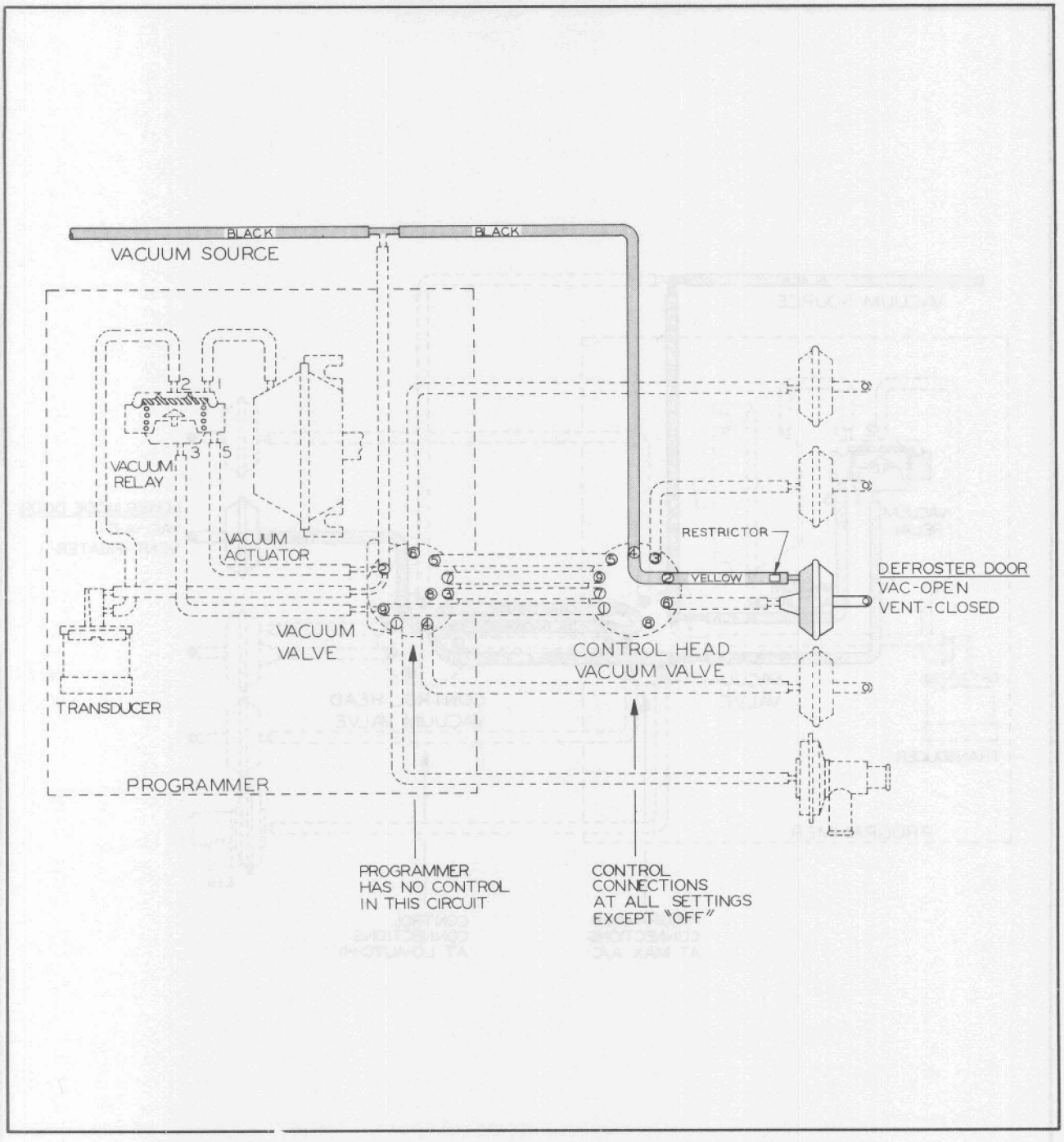


Fig. 1-49 Defroster Bleed Vacuum Circuit

Defroster Bleed Vacuum Circuit (Fig. 1-49)

To provide a small "bleed" of air to the defroster outlet in heater mode, the defroster door is open approximately .75 inch. This is accomplished by applying vacuum to the outer nipple of the two-stage defroster actuator. The outer port is connected by the yellow hose to port 2 on the control head. This port is connected to port 4 at all lever settings except "Off" in which case port 2 is vented. This provides the possibility of defroster bleed at all settings except "Off". The programmer exerts an indirect influence in this function; if it, in conjunction with the control head valve, provides vacuum to put the mode doors in the A/C positions, these doors intercept all air headed toward the defroster door and there is no defroster bleed air even though the defroster door is cracked open. Note that port 4, which feeds vacuum to the defroster bleed nipple, is connected to raw engine vacuum, not checked vacuum. This is done deliberately to permit the vacuum to escape when the car is stopped so that the defroster door will seal. A restrictor is located in the yellow hose to provide a delay of approximately 45 seconds in the operation of the door. This prevents fogging of the windshield that can sometimes occur when the car is restarted.

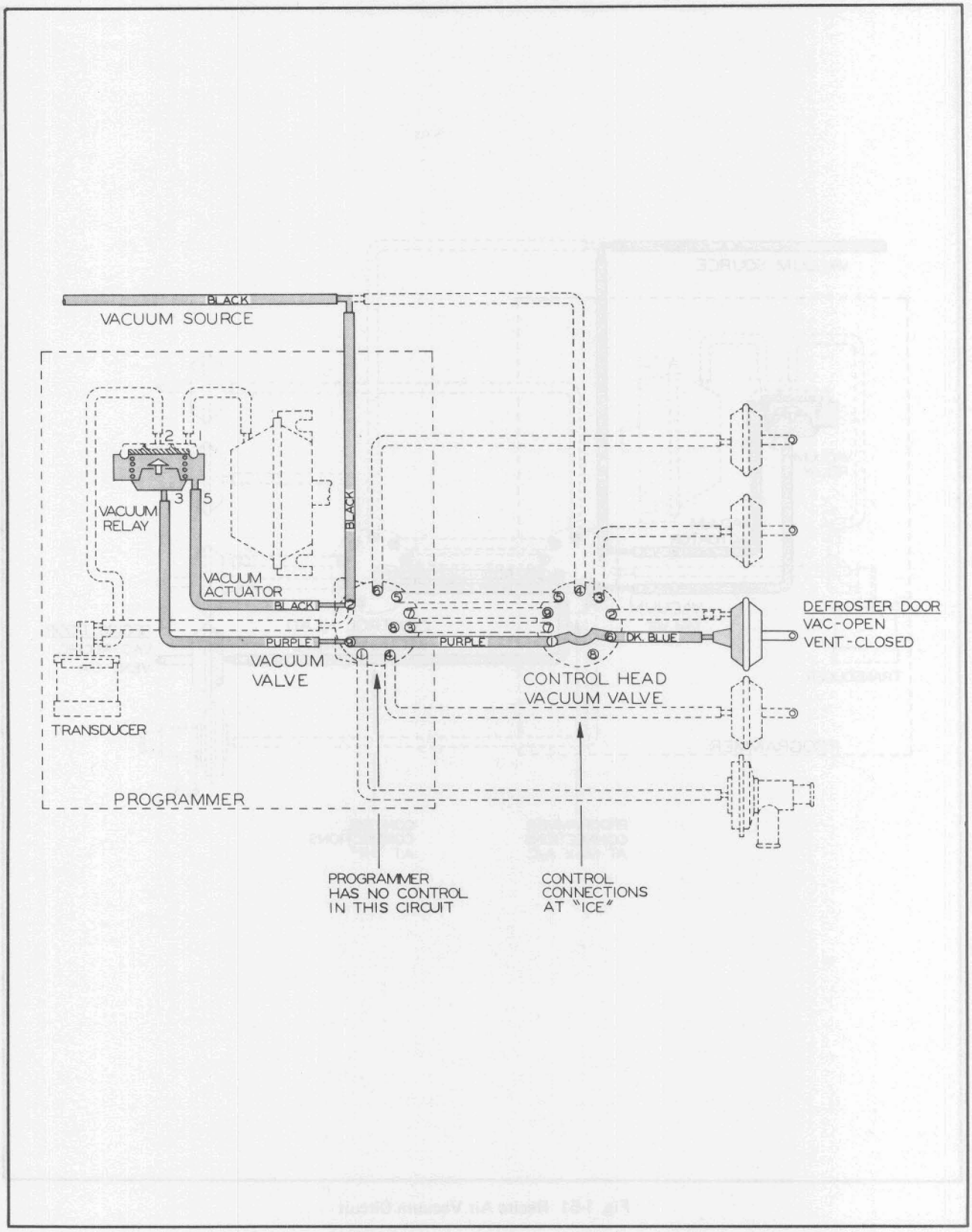


Fig. 1-50 Defroster Vacuum Circuit

Defroster Vacuum Circuit (Fig. 1-50)

The defroster door is moved full open when vacuum is applied to the center nipple of the actuator. This nipple is connected by the dark blue hose to port 6 on the control head. This port is vented at all settings except "Def" where it is connected to port 1, as shown. The programmer has no control in this circuit.

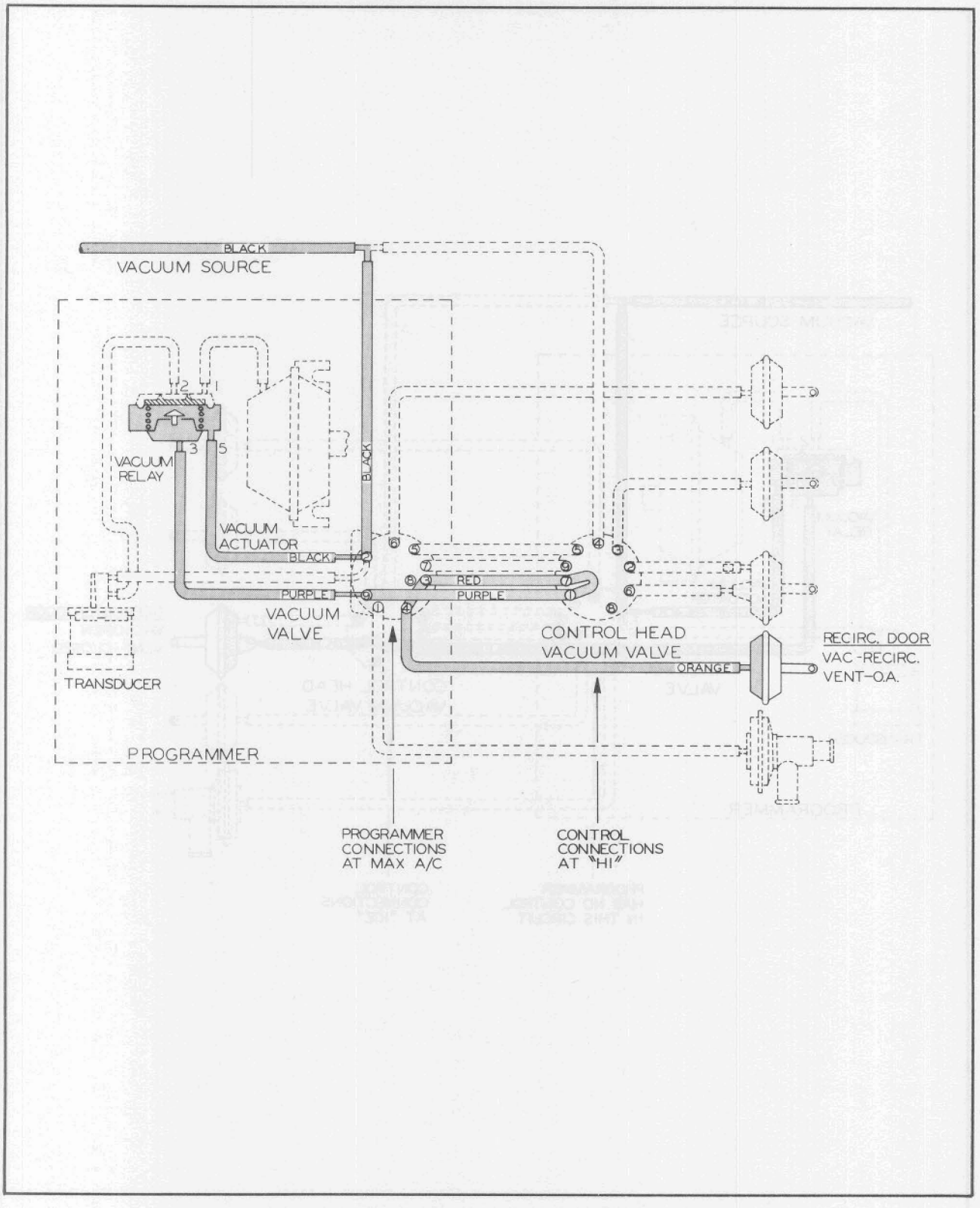


Fig. 1-51 Recirc Air Vacuum Circuit

Recirc Air Vacuum Circuit (Fig. 1-51)

The recirc air actuator is connected by the orange hose to port 4 on the programmer. This port is vented at all programmer positions except "Max A/C", resulting in outside air. At "Max A/C", port 4 is connected to port 3 which is connected by the red hose to port 7 on the control head. Port 7 is connected to checked vacuum at port 1 at the "Hi" setting (also at "Bi-Level" and "Def"), as shown. Thus, if the programmer is at "Max A/C" and the control is at "Hi", recirc air operation will be obtained.

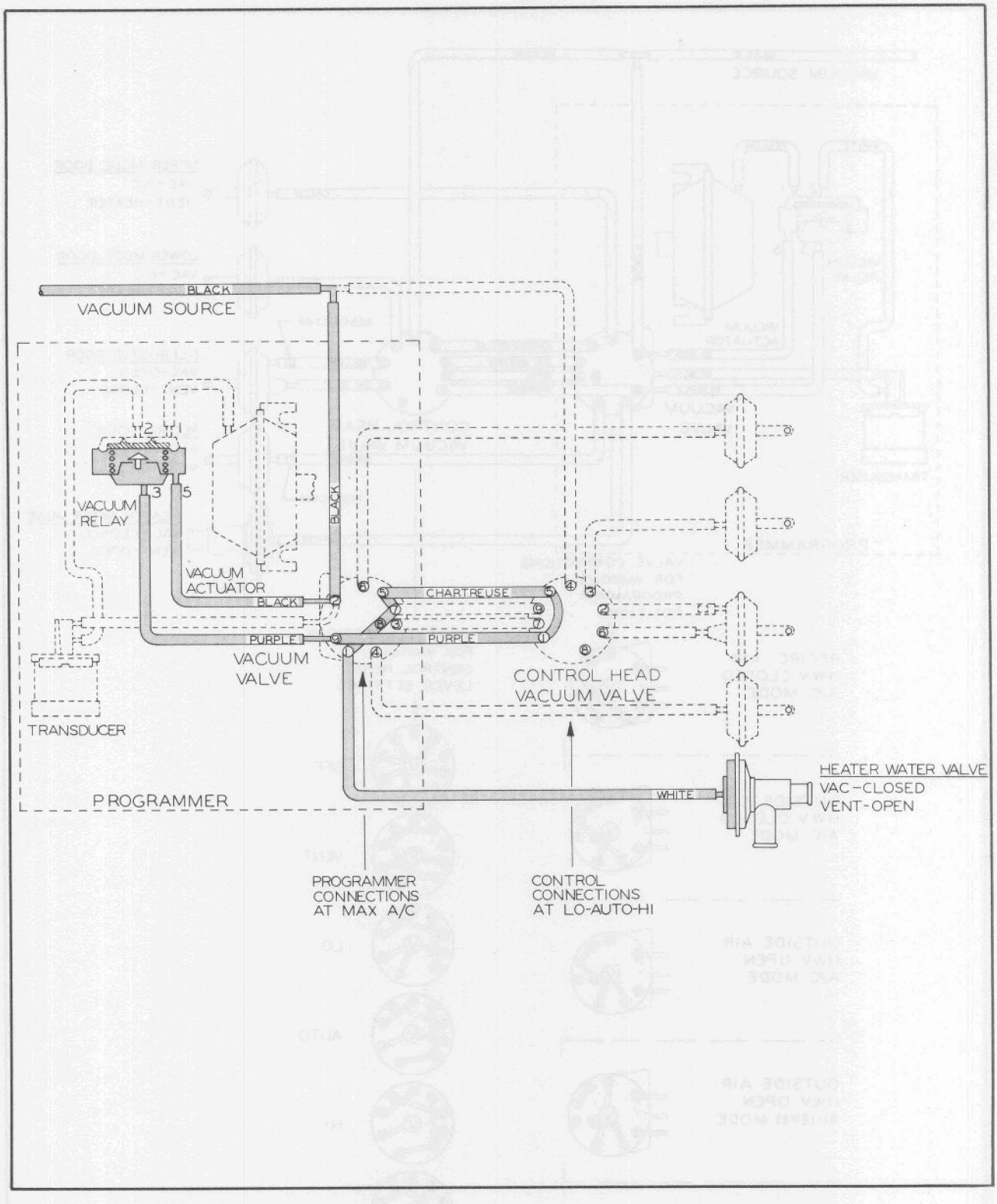


Fig. 1-52 Heater Water Valve Vacuum Circuit

Heater Water Valve Vacuum Circuit (Fig. 1-52)

The water valve is connected to port 1 of the programmer which is vented, opening the valve, at all programmer positions except at the "Max A/C" end of travel. There it is connected, as shown, to port 5 which is connected by the chartreuse hose to port 5 on the control head. At "Vent", "Lo", "Auto" and "Hi", port 5 is connected to checked vacuum at port 1, closing the valve.

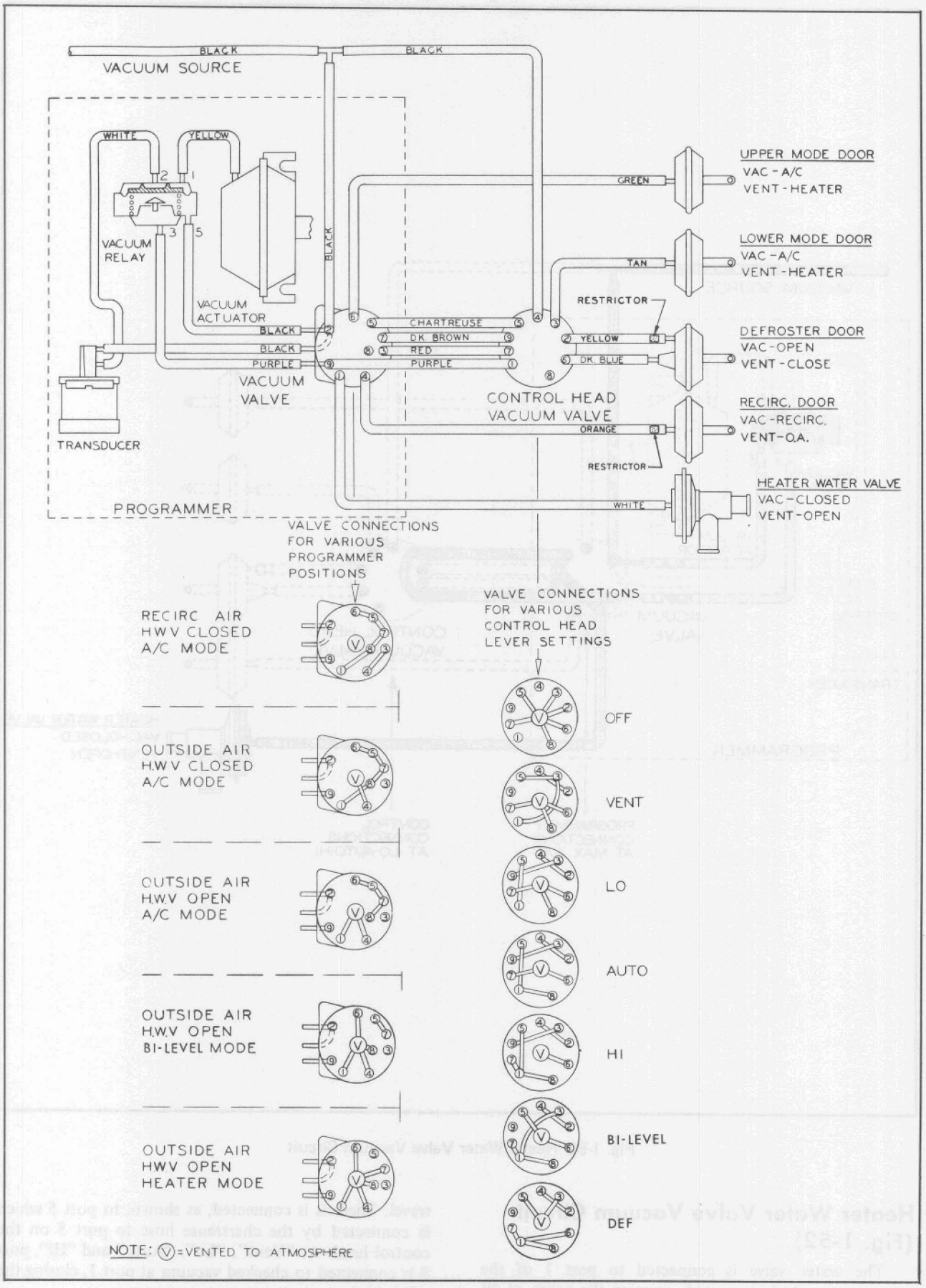


Fig. 1-53 Complete Vacuum Circuit

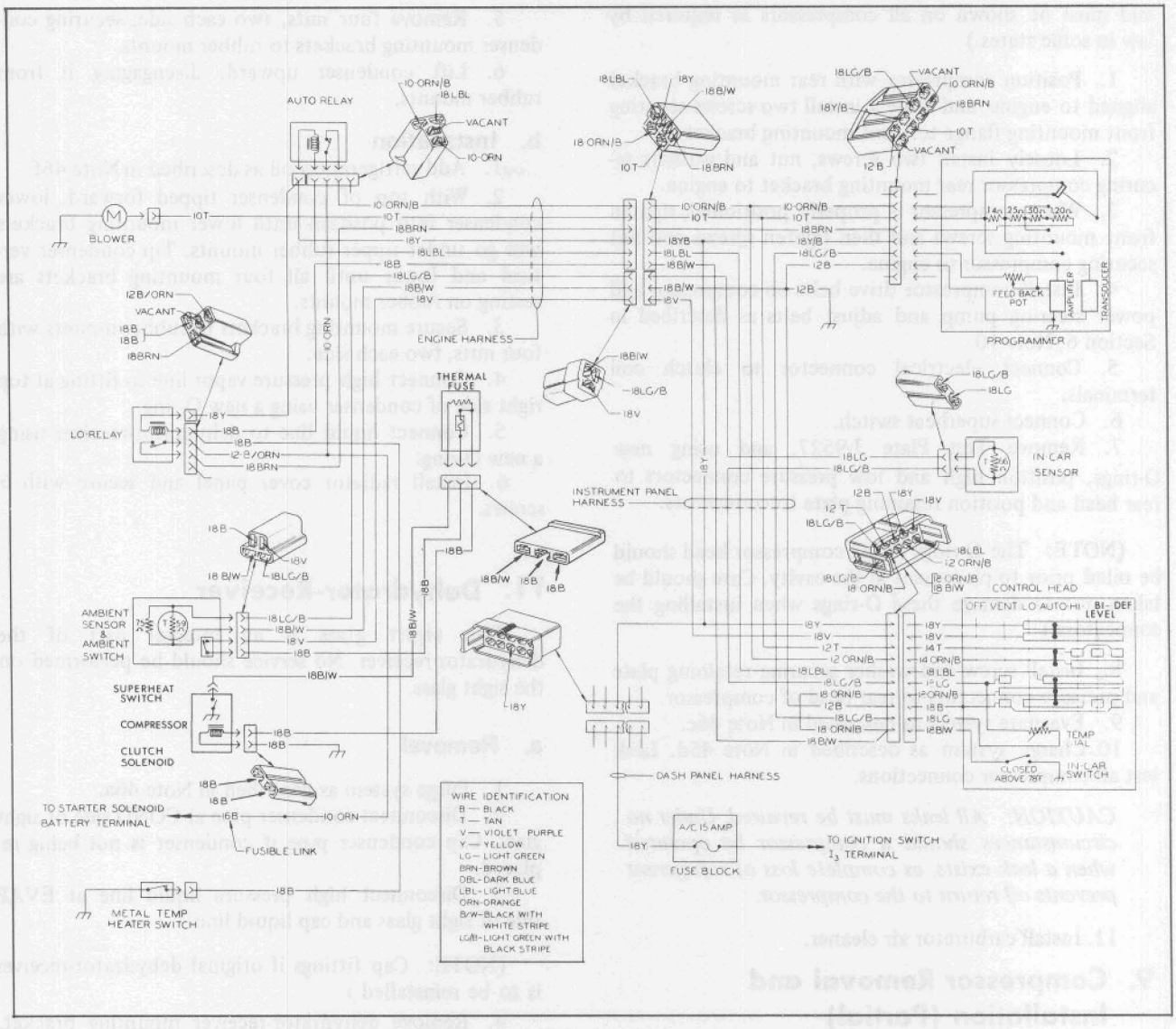


Fig. 1-54 Complete Electrical Circuit

SERVICE INFORMATION—FRONT A/C—ALL SERIES

REMOVAL AND INSTALLATION PROCEDURES

8. Compressor Removal and Installation (Complete)

a. Removal

1. Remove Carburetor air cleaner.
2. Purge system as described in Note 46a.
3. Remove screw securing plate retaining high and low pressure connectors to compressor rear head, and remove plate.
4. Remove high and low pressure connectors from rear head of compressor and cap connectors.
5. Cover compressor openings with Test Plate, J-9527, to prevent dirt from entering compressor.
6. Disconnect electrical connector from clutch coil terminals.
7. Disconnect superheat switch.
8. Loosen bolts securing power steering pump to mounting brackets, pivot pump toward engine, and remove drive belts from compressor.
9. Remove two screws, nut and washers securing compressor rear mounting bracket to engine.
10. Remove two screws securing compressor mounting flange to front mounting bracket.
11. Remove compressor by moving upward and rearward.

b. Installation

(NOTE: Before installing a replacement compressor, make certain the numeral 4 (5¼ on Fleetwood Seventy-Fives) is stamped 1/8 inch high on blank space provided in lower right hand corner of compressor name plate. If numeral is not evident, then stamp numeral as indicated. This numeral indicates the refrigerant capacity

and must be shown on all compressors as required by law in some states.)

1. Position compressor with rear mounting bracket aligned to engine, and loosely install two screws securing front mounting flange to front mounting bracket.
2. Loosely install two screws, nut and washers securing compressor rear mounting bracket to engine.
3. When compressor is properly positioned, tighten front mounting screws and then tighten screws and nut securing compressor to engine.
4. Install compressor drive belts on compressor and power steering pump and adjust belts as described in Section 6, Note 10.
5. Connect electrical connector to clutch coil terminals.
6. Connect superheat switch.
7. Remove Test Plate J-9527, and using new O-rings, position high and low pressure connectors to rear head and position retaining plate to connectors.

(NOTE: The O-rings in the compressor head should be oiled prior to placement in the cavity. Care should be taken not to damage these O-rings when installing the connectors.)

8. Install screw and washer securing retaining plate and pressure connectors to rear head of compressor.
9. Evacuate system as described in Note 46c.
10. Charge system as described in Note 45d. Leak test all compressor connections.

CAUTION: All leaks must be repaired. Under no circumstances should a compressor be operated when a leak exists, as complete loss of refrigerant prevents oil return to the compressor.

11. Install carburetor air cleaner.

9. Compressor Removal and Installation (Partial)

In order to perform certain engine operations it is necessary to move the compressor out of the way. This can be done without disconnecting any lines as follows:

a. Removal

1. Remove carburetor air cleaner.
2. Perform steps 6 through 10, Note 8a.
3. Move complete assembly clear of working area, being careful not to kink hoses. Use rope or wire to hold compressor out of way.

b. Installation

1. Perform Steps 1-6, Note 8b.
2. Install carburetor air cleaner.
3. Check system performance to assure no freon was lost and system performs normally.

10. Condenser

a. Removal

1. Purge system as described in Note 46a.
2. Remove 6 screws securing radiator cover panel and remove panel.
3. Disconnect line from "Evap." side of receiver.
4. Disconnect high pressure vapor line at fitting on top right side of condenser.
5. Remove four nuts, two each side, securing condenser mounting brackets to rubber mounts.
6. Lift condenser upward, disengaging it from rubber mounts.

b. Installation

1. Add refrigeration oil as described in Note 46f.
2. With top of condenser tipped forward, lower condenser into position until lower mounting brackets will go under upper rubber mounts. Tip condenser vertical and lower until all four mounting brackets are resting on rubber mounts.
3. Secure mounting brackets to rubber mounts with four nuts, two each side.
4. Connect high pressure vapor line to fitting at top right side of condenser using a new O-ring.
5. Connect liquid line to dehydrator-receiver using a new O-ring.
6. Install radiator cover panel and secure with 6 screws.

11. Dehydrator-Receiver

The sight glass is an integral part of the dehydrator-receiver. No service should be performed on the sight glass.

a. Removal

1. Purge system as described in Note 46a.
2. Disconnect condenser pipe at COND side of sight glass. Cap condenser pipe if condenser is not being replaced.
3. Disconnect high pressure liquid line at EVAP side of sight glass and cap liquid line.

(NOTE: Cap fittings if original dehydrator-receiver is to be reinstalled.)

4. Remove dehydrator-receiver mounting bracket.
5. Remove dehydrator-receiver by tilting unit and lifting out of engine compartment.

b. Installation

CAUTION: Do not uncap new assembly, except to add refrigeration oil, unitl it is clamped in position, as it will quickly absorb moisture from the air, decreasing its efficiency or rendering it completely useless. Keep it capped at all times.

1. Install refrigeration oil, as described in Note 46f, if new dehydrator-receiver is to be installed, and recap dehydrator-receiver.
2. Position dehydrator-receiver in mounting bracket, making certain it engages locating tab and secure with one screw.

(NOTE: Make certain dehydrator-receiver fittings are in line with condenser pipe and high pressure liquid line before tightening mounting bolts.)

3. Remove caps from COND side of dehydrator-receiver and condenser pipe and install condenser pipe to COND fitting side of sight glass, using a new O-ring.

4. Remove caps from EVAP side of dehydrator-receiver and high pressure liquid line and install high pressure liquid line to EVAP fitting side of sight glass, using a new O-ring.
5. Install high pressure line at condenser.
6. Evacuate system as described in Note 46c.
7. Charge system with refrigerant as described in Note 46d and leak test dehydrator-receiver and condenser connections.
8. Check operation of system.

12. Programmer

a. Removal

1. Open glove compartment door and remove compartment liner as described in Section 12, Note 71a.
2. Remove two clips from vacuum valve studs and disconnect vacuum harness from programmer vacuum valve.
3. Disconnect electrical harness from programmer.
4. Disconnect door link from programmer output shaft.
5. Remove three screws securing programmer to heater case and remove programmer.

b. Installation

1. Position programmer to heater case - secure with three screws.
2. Connect electrical connector to programmer.
3. Connect vacuum harness to programmer vacuum valve. Secure harness with clips on pins of valve.
4. Install door link and adjust as described in Note 48b.
5. Install glove compartment liner as described in Section 12, Note 71b.

13. Blower Relay (Lo or Auto)

a. Removal

1. Remove two electrical connectors from relay.
2. Remove two self-tapping screws securing relay to evaporator case and remove relay.

b. Installation

1. Position relay on evaporator case and secure with two self-tapping screws, Fig. 1-33.
2. Connect two electrical connectors.

14. Evaporator Case

a. Removal

1. Purge system as described in Note 46a.
2. Remove electrical connections from ambient sensor and both blower relays.

(NOTE: Steps 3 and 4 may be deleted on Eldorado.)

3. Support front of hood and tape a pad to the right-hand rear corner.
4. Remove right-hand hood hinge. Note number and placement of shims.
5. Remove high pressure line from X-valve and position out of way.
6. Remove low pressure line from P.O.A. valve and position out of way.
7. Remove right-hand tie strut at wheel house and position out of way.
8. Remove one nut and five screws securing evaporator case to cowl.
9. Remove four screws holding evaporator case to air inlet and separate evaporator case from air inlet. Gasket must be cut apart at air inlet-to-evaporator case joint.
10. Remove evaporator case and air inlet. Remove vacuum hose from recirc. door actuator.

b. Installation

1. Position air inlet near cowl and connect vacuum hose to recirc door actuator. Cement gasket to cowl opening.
2. Position evaporator case near cowl and secure to air inlet with four screws.
3. Secure evaporator case to cowl with five screws and one nut.
4. Connect high pressure line to X-valve using a new O-ring.
5. Connect low pressure line to P.O.A. valve using a new O-ring.
6. Reinstall right-hand tie strut to wheel house.
7. Install right-hand hood hinge (except 693).

(NOTE: Install shims as removed.)

8. Remove hood support and pad from corner of hood (except 693).
9. Make electrical connections to ambient sensors and blower relays.
10. Evacuate system as described in Note 46c.
11. Charge system as described in Note 46d, and leak test all connections.

15. Evaporator Core

a. Removal

1. Remove evaporator case as described in Note a.
2. Disconnect line from X-valve to P.O.A. valve.
3. Disconnect line from bottom of X-valve.
4. Remove gasket from cowl side of evaporator case.
5. Remove six screws holding case halves together and separate case halves.
6. Remove clamp at X-valve and clamp at P.O.A. valve.
7. Slide evaporator core out of case.

b. Installation

1. Position evaporator in location in case halve. Check to assure proper seal of core to case.
2. Secure P.O.A. valve and X-valve with clamps.
3. Install new seal and position case halves together. Secure with six screws.
4. Add refrigeration oil as described in Note 46f.
5. Using new O-rings, reconnect lines to X-valve and P.O.A. valve.
6. Position gasket to cowl side of evaporator case and hold in place with trim cement.
7. Install evaporator case as described in Note 14b.

16. POA Suction Throttling Valve

a. Removal

1. Purge system as described in Note 46a.
2. Disconnect low pressure vapor line from suction throttling valve and cap line.
3. Disconnect oil bleed line and external equalizer line from suction throttling valve.
4. Remove screw securing suction throttling valve clamp to brace on front of blower-evaporator assembly case.
5. Disconnect fitting on evaporator outlet pipe from POA suction throttling valve and remove valve.
6. Remove clamp from suction throttling valve.

b. Installation

1. Install clamp on suction throttling valve.
2. Connect suction throttling valve to fitting on evaporator outlet pipe, using a new O-ring.
3. Position suction throttling valve clamp to brace on front of blower-evaporator assembly case, and secure with screw.
4. Using new O-rings, connect equalizer and oil bleed lines to suction throttling valve.
5. Connect low pressure vapor line to suction throttling valve, using a new O-ring.
6. Evacuate system as described in Note 46c.
7. Charge system as described in Note 46d, and leak test all connections.
8. Check operation of system.

17. Expansion Valve

a. Removal

1. Purge system as described in Note 46a.
2. Remove insulation from power element bulb on evaporator outlet pipe and remove bulb clamp and bulb. Note routing of small tubes before removal.
3. Disconnect external equalizer line from POA suction throttling valve.
4. Disconnect high pressure liquid line from expansion valve and cap line.
5. Remove screw securing expansion valve clamp to brace on front of blower-evaporator assembly case.
6. Disconnect expansion valve from evaporator inlet pipe fitting and remove expansion valve.
7. Remove clamp from expansion valve.

b. Installation

1. Install clamp on expansion valve.
2. Using a new O-ring, connect expansion valve to evaporator inlet pipe fitting.
3. Install screw securing expansion valve clamp to brace on front of blower-evaporator assembly case.
4. Connect high pressure liquid line to expansion valve using a new O-ring.
5. Using a new O-ring, connect external equalizer line to suction throttling valve.
6. Attach power element bulb to evaporator outlet pipe and secure with clamp.

(NOTE: Use new clamp, if necessary, to obtain tight fit of bulb to tubing. Carefully route small tubes to clear water hoses.)

7. Carefully replace insulation around power element bulb, as insulation must be packed tightly around bulb.
8. Evacuate system as described in Note 46c.
9. Charge system as described in Note 46d and leak test all connections.
10. Check operation of system.

18. Blower Motor

a. Removal

1. Disconnect negative battery cable.
2. Remove rubber cooling hose from nipple and blower motor.
3. Disconnect electrical connector at lead to motor.
4. Remove six screws securing blower to case and remove blower.

b. Installation

1. Install ground wire to blower flange screw at 5 o'clock position.
2. Secure capacitor to blower flange screw at 5 o'clock position.
3. Place a bead of sealer around opening where blower will contact case.
4. Guide blower motor against cowl and place on locating dowel.
5. Install five screws securing blower to case.
6. Connect electrical connector at lead to motor.
7. Install cooling hose on motor and nipple.

19. Heater Case

a. Removal

1. Drain radiator coolant.
2. Remove hoses from heater core nipples.
3. Remove instrument panel top cover as described in Section 12, Note 40a.
4. Remove right and left A/C outlet hoses and center outlet connector.
5. Remove two screws securing A/C distributor to heater case and remove distributor, Fig. 1-10.
6. Remove one screw securing defroster nozzle to heater case and remove nozzle from under clips and out of car, Fig. 1-13.
7. Remove glove compartment liner as described in Section 12, Note 71a.
8. Disconnect vacuum hoses at recirc door, water valve, control head and supply hose.
9. Disconnect aspirator hose from in-car sensor.
10. Remove instrument panel center vertical brace.
11. Remove instrument panel center horizontal brace.
12. Remove four nuts securing heater case to cowl on engine side of cowl, Fig. 1-9.
13. Remove heater case from position under instrument panel being careful to hold case as upright as possible to avoid spilling coolant from heater core nipples on carpet.

b. Installation

1. Position heater case under instrument panel as shown in Fig. 1-9. Do not position to cowl.
2. Install heater case in position on cowl, Fig. 1-9, and secure with four nuts on engine side of cowl.
3. Install heater hoses to heater core nipples and replace coolant.
4. Connect vacuum hose at recirc door, water valve, control head and supply. Color codes are shown in Fig. 1-53.
5. Install instrument panel center vertical brace.
6. Install instrument panel center horizontal brace.
7. Install defroster nozzle as shown in Fig. 1-13 under clips and secure with one screw to heater case.
8. Install A/C distributor under clip on heater case and secure with two screws.
9. Install rubber connector between center A/C distributor and center A/C outlet.
10. Install left and right outlet hoses, Fig. 1-10.
11. Install instrument panel top cover as described in Section 12, Note 40b.
12. Connect aspirator hose to in-car sensor and make vacuum and electrical connections to programmer, working through glove compartment opening.
13. Install glove compartment liner as described in Section 12, Note 71b.

20. Heater Core

a. Removal

1. Remove heater case as described in Note 19.
2. Remove rubber seal from around core water nipples.
3. Remove screw and clip from beneath seal.
4. Remove two screws and clip from opposite end of core and remove core from position in case.

b. Installation

1. Locate heater core in position in heater case.
2. Secure bottom of core with clip and two screws.
3. Secure top of core with clip and screw.
4. Install rubber seal over water nipples.
5. Install heater case as described in Note 19.

21. Water Control Valve

(NOTE: The thermal vacuum valve is installed on 697 rear units only and is serviced with the water control valve as an assembly.)

a. Removal (Fig. 1-33)

1. Clamp off valve inlet and outlet water hoses.
2. Remove vacuum hose from water control valve.
3. On 697 rear units, remove vacuum hoses from thermal vacuum valve.
4. Remove clamps securing hoses to valve, and remove valve from hoses.

b. Installation

1. Install water valve on inlet and outlet hoses and install clamps.
2. Remove clamps from hoses.
3. On all but 697 rear units, install white vacuum hose at water control valve.
4. On 697 rear units, install red vacuum hose at water control valve. Install yellow and purple vacuum hoses on thermal vacuum valve so yellow hose connects to vacuum nipple closest to water outlet fitting.
5. Replace any coolant lost.

22. Air Conditioning Outlets

The procedures for removing and installing the outlets are described in Section 12, Note 66.

23. In-Car Sensor

The procedure for removing and installing the in–car sensor and switch is described in Section 12, Note 65.

24. Ambient Sensor and Switch

a. Removal (Fig. 1-28)

1. Disconnect electrical connector from sensor terminals.
2. Remove two screws securing sensor to evaporator case and remove sensor.

b. Installation

1. Position sensor on evaporator case and secure with two screws.
2. Connect electrical connector at sensor terminals.

25. Automatic Climate Control Air Conditioner Control Panel

The procedure for removing and installing the control panel is described in Section 12, Note 64.

26. Air Conditioning Control Panel Disassembly and Assembly

The control panel must be removed as described in Section 12, Note 64 to perform any of the following procedures.

a. Circuit Board Removal

1. Remove one screw securing wire harness clip to control head base plate.
2. Remove two green wires from temperature dial rheostat.
3. Remove three screws on bottom of base plate securing circuit board to base plate.

4. Move control lever to "OFF" position and remove circuit board by sliding out from under control lever.

b. Circuit Board Installation

1. Move control lever to DEF position and feed circuit board connector and wires through base plate from bottom.

CAUTION: This procedure is important to avoid damage to the wiper contacts on bottom of control lever.

2. Work circuit board into position and secure to base plate with three screws.

3. Working on top side of control head, connect two green wires to temperature dial rheostat, Fig. 1-30.

4. Secure harness clip to base plate with one screw, Fig. 1-30.

c. Temperature Dial Rheostat Removal

1. Disconnect two green leads from rheostat terminals.

2. Remove two screws securing rheostat bracket to mounting plate and remove rheostat.

d. Temperature Dial Rheostat Installation

1. Position rheostat to control panel and install two screws securing rheostat bracket to mounting plate.

2. Connect two green wires to rheostat terminal.

3. After installing control panel on car, adjust temperature dial as indicated in Note 50a.

e. Control Head Vacuum Valve Removal

1. Loosen two screws securing control vacuum valve to control head and remove valve.

f. Control Vacuum Valve Installation

1. Position control vacuum valve on control head so that pin engages lever arm.

2. Secure with two screws.

27. Superheat Switch Replacement

a. Removal

1. Completely discharge air conditioning system as described in Note 46a.

2. After system is discharged, remove superheat switch retainer ring, using Snap Ring Pliers, J-5403.

3. Remove superheat switch from rear head by pulling at terminal housing groove with a pair of pliers.

4. Remove "O" ring from switch cavity in rear head. Use Oil Pick-Up Tube Remover, J-5139, or a wire with a hook on the end.

5. Recheck superheat switch for closed contacts. See superheat switch check in diagnosis section on page 1-14. Replace as necessary.

b. Installation

1. Check superheat switch cavity and "O" ring groove in rear head for dirt or foreign material and be sure area is clean before installing "O" ring. Lubricate "O" ring liberally with 525 viscosity oil, and install "O" ring in groove of superheat switch cavity in rear head. ("O" ring is part of the new switch kit.)

2. Lubricate housing of superheat switch with 525 viscosity oil and insert switch carefully into switch cavity until switch bottoms.

3. Using Snap Ring Pliers, J-5403, install superheat switch retainer ring with high point of the curved sides next to the switch housing. Be sure the retainer ring is properly seated in the snap ring groove.

4. Check for electrical continuity between switch housing and rear head. Also check for continuity between terminal and switch housing to be sure the contacts are open.

5. Evacuate and recharge system with refrigerant, according to the following special charging procedure.

CAUTION: To prevent the possibility of "blowing" the new thermal fuse during evacuation, charging, or analysis of the system, disconnect the connector plug from the thermal fuse and install a jumper between the center terminal "B" and the clutch lead terminal "C" of the connector plug.

a. Evacuate, recharge and leak check entire A/C system according to procedure described in Note 46. Repair any leaks, check and add oil as required for proper operation of system.

b. When system is operating normally, remove jumper from connector plug and reconnect plug to thermal fuse.

COMPRESSOR OVERHAUL

28. Compressor Service

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to Fig. 1-82 for information relative to parts nomenclature and location.

Some service operations can be performed without disturbing the internal mechanism assembly or completely removing the compressor from the car. Among them are replacement of the clutch plate and hub assembly, the pulley and bearing assembly, and pulley bearing.

The clutch coil and housing assembly also may be replaced without completely removing the compressor, after clutch and pulley parts have been removed. It is not necessary to disturb the shaft seal.

The shaft seal assembly can be replaced only by removing the compressor from the car and removing the clutch plate and hub assembly to gain access to the seal. A complete kit of shaft seal parts is available for field replacement.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. The work area, tools, and parts must be kept clean at all times. Parts Tray, J-9402, should be used for all parts being removed as well as for replacement parts.

Although certain service operations can be performed without completely removing the compressor from the car, the operations described herein are based on bench overhaul with the compressor removed from the car. They have been prepared in sequence in order of accessibility of the components.

When a compressor is removed from the car for servicing, the amount of oil remaining in the compressor should be drained and measured. This oil should then be discarded and new oil added to the compressor as described in Note 46f.

29. Compressor Clutch Plate and Hub Assembly

a. Removal

1. Place Holding Fixture, J-9396, in a vise, and secure compressor to fixture with pulley end up.
2. Keep clutch hub from turning with Clutch Hub Holding Tool, J-9403, and remove locknut from end of shaft using Thin Wall Socket, J-9399, Fig. 1-55.
3. Thread Clutch Plate and Hub Assembly remover, J-9401, into hub. Hold body of tool with a wrench and tighten center screw to remove clutch plate and hub assembly, Fig. 1-56.
4. Remove square drive key from shaft.
5. Remove hub retainer ring using Snap Ring Pliers, J-5403 (#21), and then remove hub spacer, Fig. 1-57.

b. Installation

1. Install square drive key on shaft, allowing it to project approximately 3/16 inch out of keyway.
2. Wipe frictional surface of clutch plate and pulley clean.
3. Place clutch plate and hub assembly on shaft, aligning shaft key with keyway in hub.

CAUTION: To avoid internal damage to compressor, do not drive or pound on hub or shaft. This could mis-position swash plate on shaft, resulting in damage to compressor.

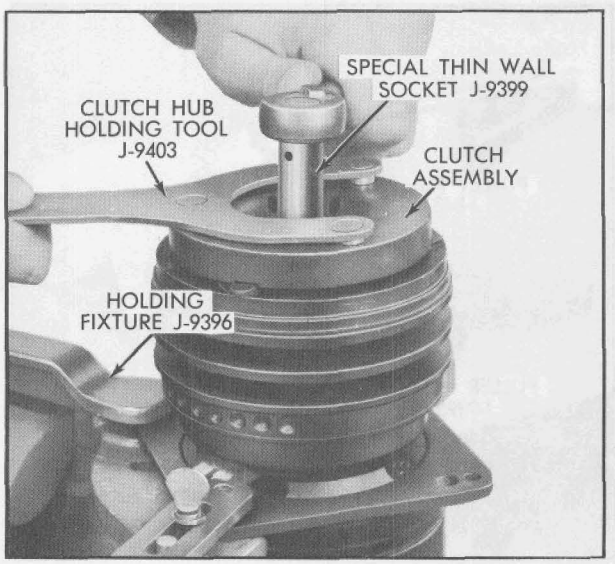


Fig. 1-55 Removing Locknut

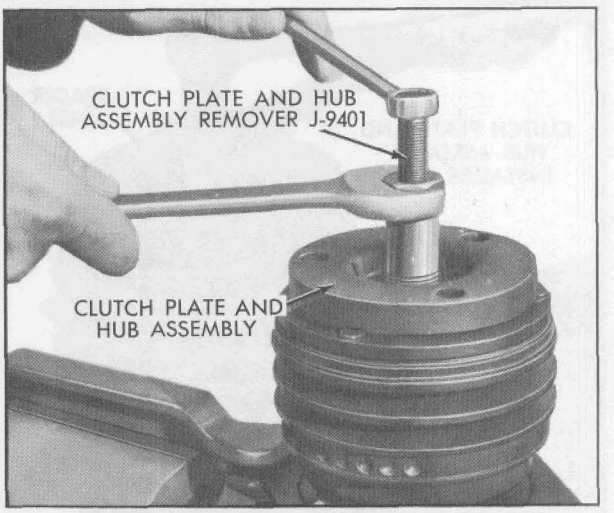


Fig. 1-56 Removing Clutch Plate And Hub Assembly

4. Place Spacer, J-9480-2, on hub, Fig. 1-82. Insert end of Clutch Plate and Hub Assembly Installer, J-9480, through spacer and thread tool onto end of shaft.
5. Hold hex portion of tool body with a wrench and tighten center screw several turns to press hub partially on shaft, Fig. 1-58.
6. Remove Clutch Plate and Hub Assembly Installer and Spacer. Check alignment of drive key with keyway in shaft. If alignment is correct, replace installer tools and continue to press hub onto shaft until there is approximately a 3/32 inch (.093 inch) air gap between frictional surfaces of pulley and clutch plate.

(NOTE: A zero thrust race is 3/32 inch thick and can be used as a gage between these frictional surfaces.)

7. Remove Installer, J-9480, and Spacer, J-9480-2.
8. Install hub spacer.
9. Using Snap Ring Pliers, J-5403 (#21), install hub retainer ring with flat side of ring facing spacer.
10. Install a new shaft locknut with small diameter boss of nut against hub spacer, using special Thin Wall Socket J-9399, Fig. 1-55. Hold clutch hub with Clutch

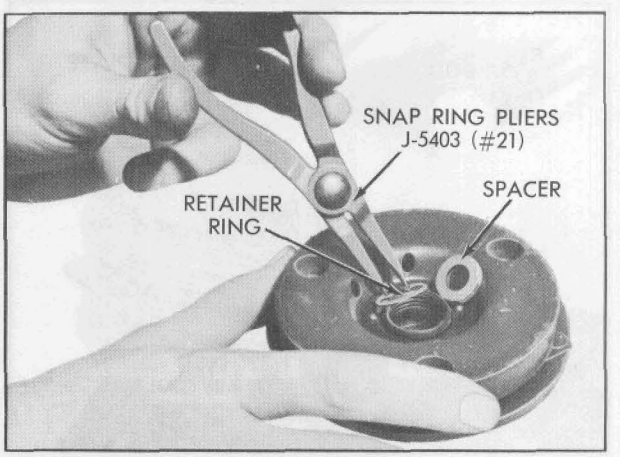


Fig. 1-57 Removing Hub Retainer Ring And Spacer

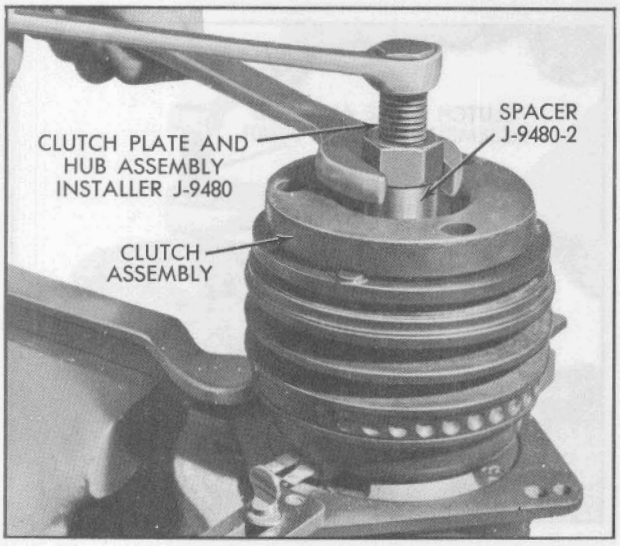


Fig. 1-58 Installing Clutch Plate And Hub Assembly

Hub Holding Tool, J-9403, and tighten nut to 15 foot-pounds torque, using a 0-25 foot pounds torque wrench. Air gap between frictional surfaces of pulley and clutch plate should now be approximately 1/32 inch (.031 inch to .057 inch), Fig. 1-57.

30. Compressor Pulley and Bearing Assembly

a. Removal

1. Remove clutch plate and hub assembly as described in Note 29a.

2. Remove pulley retainer ring using Snap Ring Pliers, J-6435 (#26), Fig. 1-60.

3. Pry out absorbent sleeve retainer, and remove absorbent sleeve from compressor neck.

4. Place Puller Pilot, J-9395, over end of compressor shaft.

CAUTION: It is important that Puller Pilot, J-9395, be used to prevent internal damage to compressor when removing pulley. Under no circumstances should Puller be used directly against drilled end of shaft.

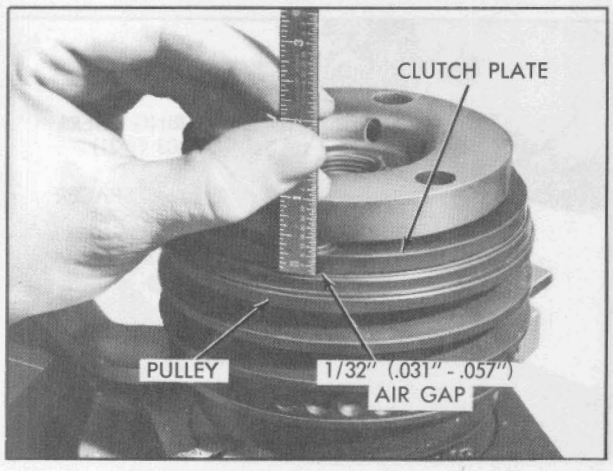


Fig. 1-59 Checking Air Gap

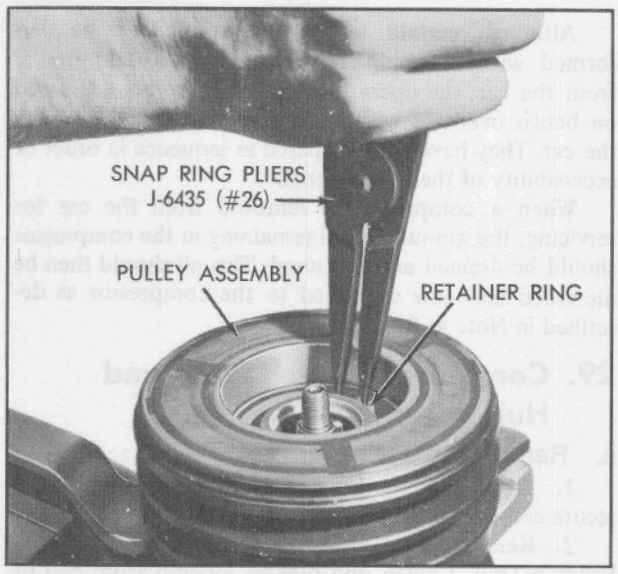


Fig. 1-60 Removing Pulley Retainer Ring

5. Remove pulley and bearing assembly using Pulley Puller, J-8433, Fig. 1-61.

b. Installation

1. If original pulley and bearing assembly is to be reinstalled, wipe frictional surface of pulley clean. If frictional surface of pulley shows any indication of damage due to overheating, pulley should be replaced.

2. Check bearing for brinelling, excessive looseness, noise, and lubricant leakage. If any of these conditions exist, bearing should be replaced. The procedure for replacing bearing is described in Note 31.

3. Press or tap pulley and bearing assembly on neck of compressor until it seats, using Pulley and Bearing

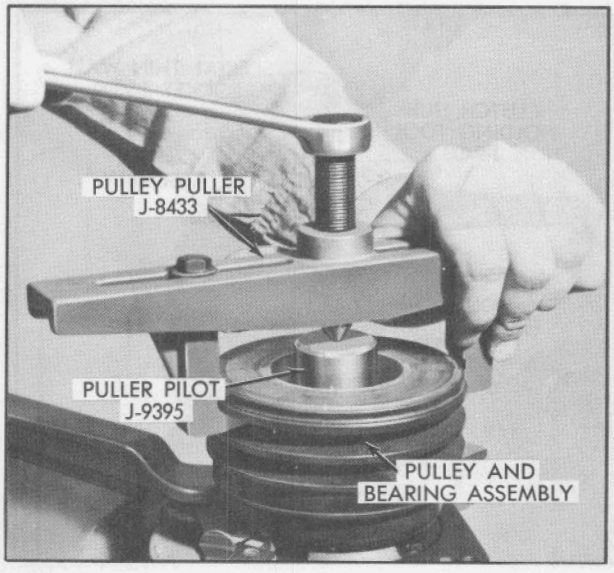


Fig. 1-61 Removing Pulley And Bearing Assembly

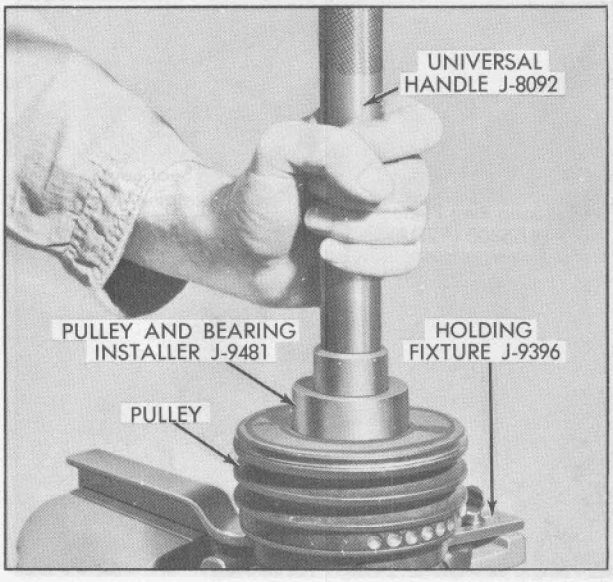


Fig. 1-62 Installing Pulley And Bearing Assembly

Installer, J-9481, with Universal Handle, J-8092, Fig. 1-62. Installer will apply force to inner race of bearing and prevent damage to bearing.

4. Check pulley for binding or roughness. Pulley should rotate freely.

5. Install retainer ring using Snap Ring Pliers, J-6435 (#26).

6. Install absorbent sleeve in compressor neck.

7. Install absorbent sleeve retainer in neck of compressor. Using sleeve from Seal Seat Remover J-9393, install retainer so that outer edge is recessed 1/32" from compressor neck face.

8. Install clutch plate and hub assembly as described in Note 29b.

31. Compressor Pulley Bearing Replacement

1. Remove clutch plate and hub assembly as described in Note 29a.

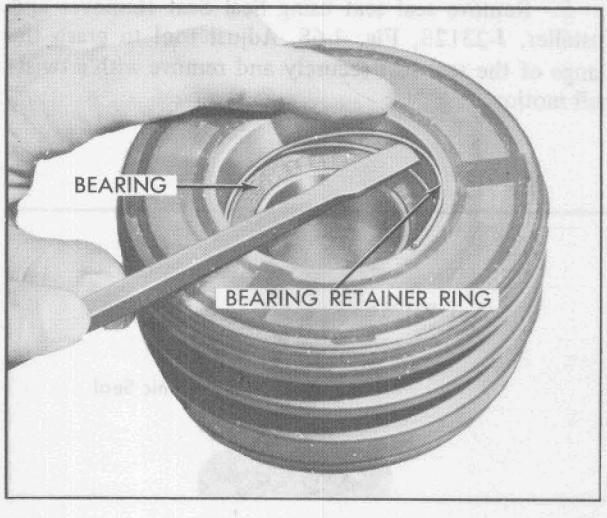


Fig. 1-63 Removing Pulley And Bearing Retainer Ring

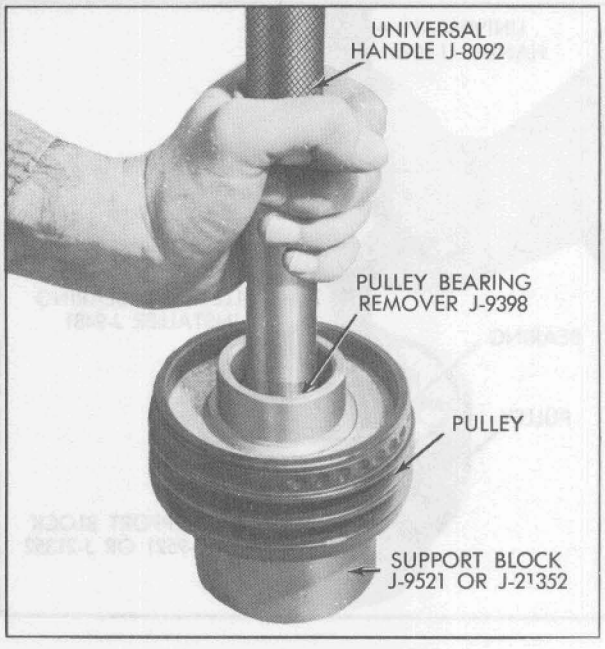


Fig. 1-64 Removing Bearing From Pulley

2. Remove pulley and bearing assembly as described in Note 30a.

3. Remove pulley bearing retainer ring with a small screwdriver or pointed tool, Fig. 1-63.

4. Place pulley and bearing assembly on inverted Support Block, J-9521, and, using Pulley Bearing Remover, J-9398, with Universal Handle, J-8092, drive bearing assembly out of pulley, Fig. 1-64.

5. Install new bearing in pulley using Pulley and Bearing Installer J-9481 with Universal Handle, J-8092, Fig. 1-65. The tool will apply the force to the outer race of the bearing.

CAUTION: Do not clean new bearing assembly with any type of solvent. Bearing is supplied with correct lubricant when assembled and requires no other lubricant at any time.

6. Install bearing retainer ring, make certain that it is properly seated in ring groove.

7. Install pulley and bearing assembly as described in Note 30b.

8. Install clutch plate and hub assembly as described in Note 29b.

32. Compressor Clutch Coil and Housing Assembly

The coil has 3.85 ohms resistance at 80°F (ambient temperature) and should draw 3.2 amps at 12 volts.

a. Removal

1. Remove clutch plate and hub assembly as described in Note 29a.

2. Remove pulley and bearing assembly as described in Note 30a.

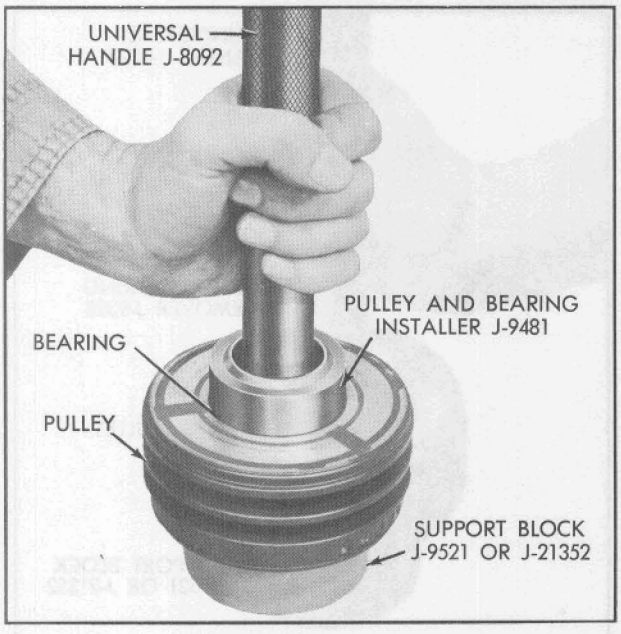


Fig. 1-65 Installing Bearing On Pulley

3. Note position of terminals on coil housing and scribe location on compressor front head casting.

4. Remove coil housing retaining ring using Snap Ring Pliers, J-6435 (#26), Fig. 1-66.

5. Lift coil and housing assembly off compressor.

b. Installation

1. Position coil and housing assembly on compressor front head casting so electrical terminals line up with marks previously scribed on compressor.

2. Align locating extrusions on coil housing with holes in front head casting.

3. Install coil housing retainer ring, with flat side of ring facing coil, using Snap Ring Pliers, J-6435 (#26).

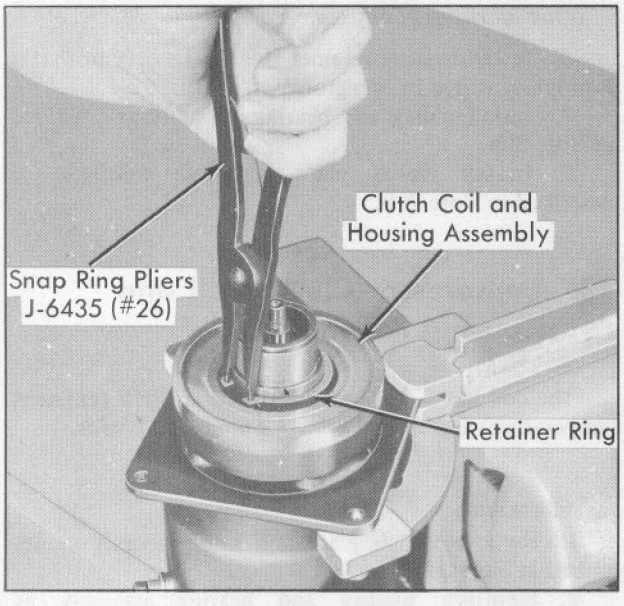


Fig. 1-66 Removing Coil Housing Retainer Ring

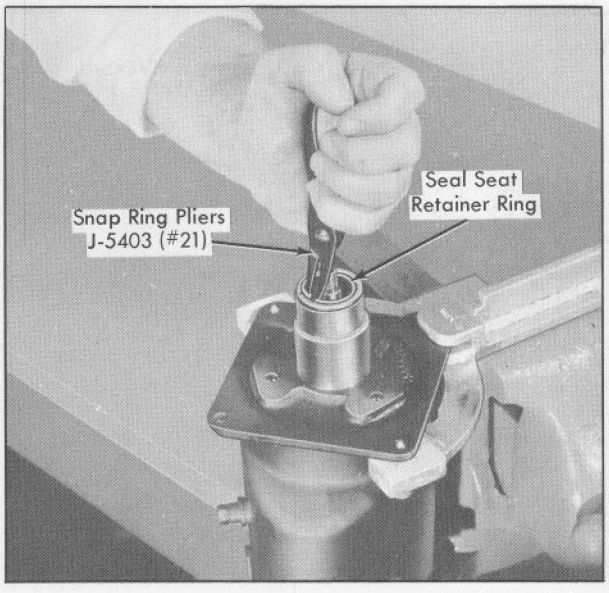


Fig. 1-67 Removing Seal Seat Retainer Ring

4. Install pulley and bearing assembly as described in Note 30b.

5. Install clutch plate and hub assembly as described in Note 29b.

33. Compressor Shaft Seal Assembly

a. Removal

1. Remove clutch plate and hub assembly as described in Note 29a.

2. Pry out sleeve retainer and remove sleeve.

3. Remove seal seat retainer ring using Snap Ring Pliers, J-5403 (#21), Fig. 1-67.

(NOTE: Illustration shows coil and housing removed. However, this is not necessary.)

4. Thoroughly clean inside of the compressor neck area surrounding the shaft, exposed portion of seal seat, and the shaft itself of any dirt or foreign material.

5. Remove seal seat using Seal Seat Remover and Installer, J-23128, Fig. 1-68. Adjust tool to grasp the flange of the seal seat securely and remove with a twist-pull motion.

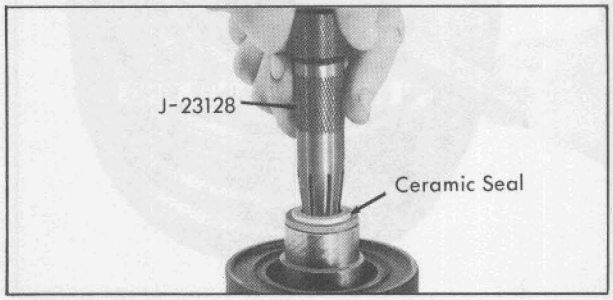


Fig. 1-68 Removing Seal Seat

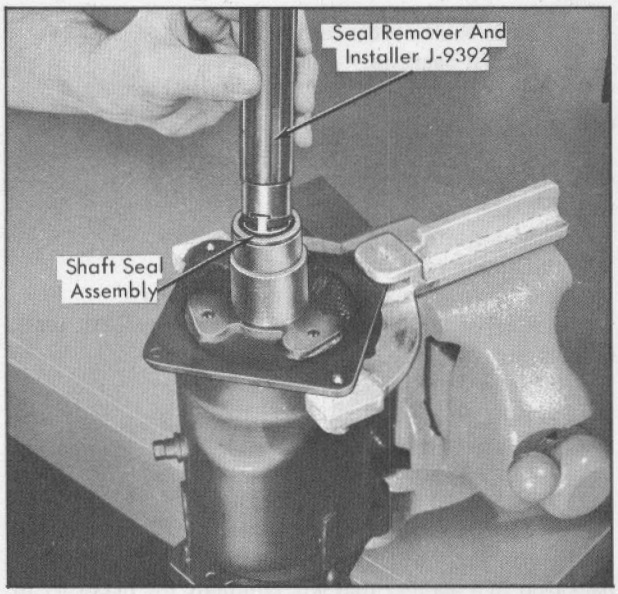


Fig. 1-69 Removing Shaft Seal Assembly

6. Remove shaft seal assembly using Seal Remover and Installer, J-9392, Fig. 1-69. Press down on tool to overcome seal spring pressure and twist tool clockwise to engage tabs on seal assembly with locking tangs on tool. Remove seal assembly by pulling straight out from shaft.

7. Remove seal seat O-ring from compressor neck. A wire with a hook formed on the end may be used, Fig. 1-70.

8. Re-check the shaft and inside of compressor neck for dirt or foreign material and be sure those areas are perfectly clean before installing new parts.

b. Installation

1. Coat new seal seat O-ring with clean refrigeration oil and install in compressor neck, making certain it is

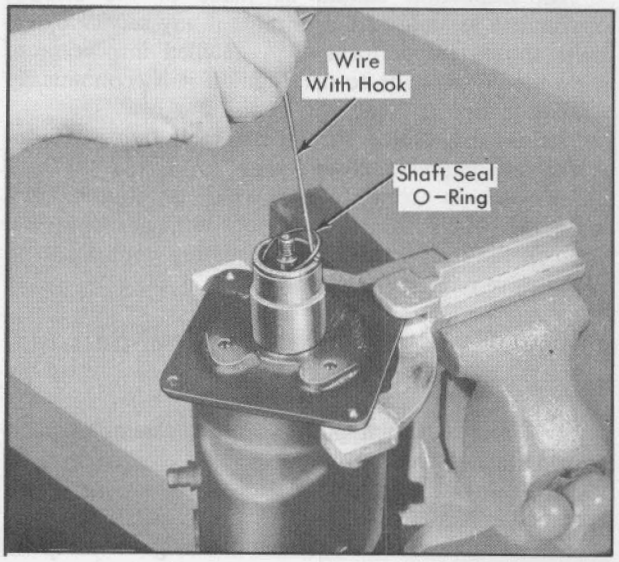


Fig. 1-70 Removing Shaft Seal O-Ring

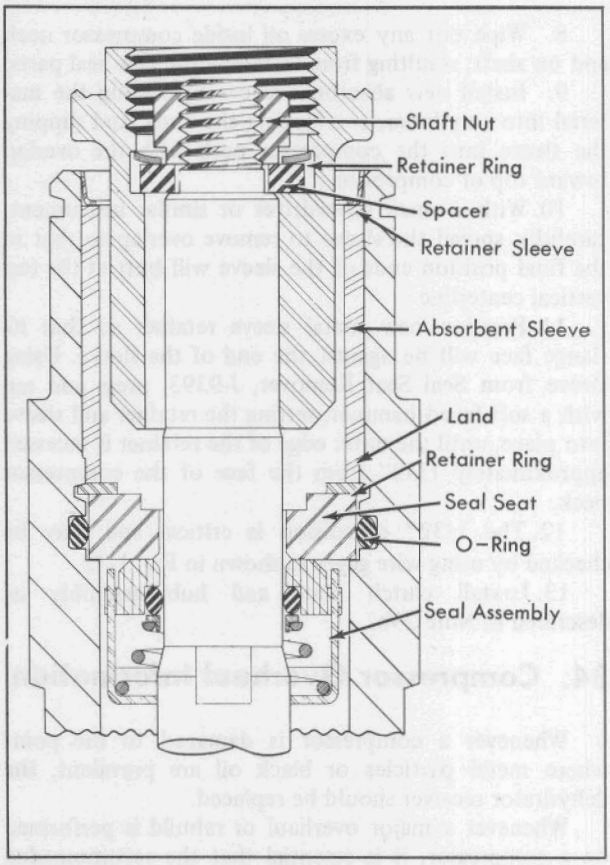


Fig. 1-71 Shaft Seal and Seat Installed

installed in bottom groove, Fig. 1-71. Top groove is for retainer ring.

2. Coat O-ring and seal face of new seal assembly with clean refrigeration oil.

3. Carefully engage tabs on new seal assembly with tangs of Seal Remover and Installer, J-9392 and install new seal assembly over flats on shaft. Turn tool counter-clockwise to release it from seal tabs and remove tool.

4. If ceramic seat is being installed, coat seal face of new seal seat with clean refrigeration oil and install new seal seat, using Seal Seat Remover and Installer, J-23128. The seal seat is installed with the tool by a twist-push motion until the seat bottoms on the compressor shaft.

5. If carbon seat is being installed, coat seal face of new seal seat with clean refrigeration oil and install new seal seat, using Seal Seat Remover and Installer, J-9393. With either type seat, make sure seal seat O-ring is not dislodged and seal seat is making a good seal with the O-ring.

CAUTION: Seal faces of seal assembly and seal seat must be protected against dirt or any damage, such as scratches and nicks. Even finger markings are to be avoided.

6. Install new seal seat retainer ring, with flat face against the seal seat, using Snap Ring Pliers, J-5403 (#21). Sleeve from Seal Seat Remover and Installer, J-9393, may be used to press on the retainer ring so that it snaps into its groove, Fig. 1-71.

7. Leak test compressor as described in Note 40. Correct any leaks found.

8. Wipe out any excess oil inside compressor neck and on shaft, resulting from installing the new seal parts.

9. Install new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and slipping the sleeve into the compressor neck with the overlap toward top of compressor.

10. With a small screwdriver or similar instrument, carefully spread the sleeve to remove overlap so that in the final position ends of the sleeve will butt at the top vertical centerline.

11. Position new metal sleeve retainer so that its flange face will be against the end of the sleeve. Using sleeve from Seal Seat Remover, J-9393, press and tap with a soft-faced hammer, setting the retainer and sleeve into place, until the outer edge of the retainer is recessed approximately 1/32" from the face of the compressor neck.

12. The 1/32" dimension is critical and may be checked by using wire gages as shown in Fig. 1-72.

13. Install clutch plate and hub assembly as described in Note 29b.

34. Compressor Overhaul Information

Whenever a compressor is damaged to the point where metal particles or black oil are prevalent, the dehydrator receiver should be replaced.

Whenever a major overhaul or rebuild is performed on a compressor, it is essential that the recommended service tools be available in order to perform the various service operations properly. In addition, an adequate supply of service parts should be available. Service parts should include the following.

1. Standard size piston drive balls.
2. Shoe discs - total of 11 sizes, including the ZERO shoe.
3. Thrust races - total of 16 sizes, including the ZERO race.
4. Pistons.

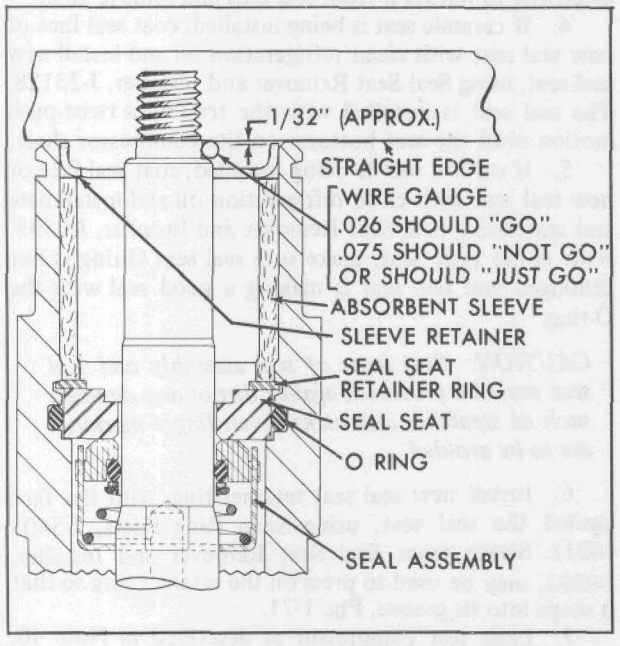


Fig. 1-72 Gaging Seal Retainer

5. Main shaft needle bearings.
6. Thrust bearings.
7. Compressor shaft, swash plate and woodruff key assembly.
8. Service cylinder assembly - front, rear halves, with main bearing in place and halves dowel pinned together.
9. Major internal mechanism assembly.
10. Suction reed valve - front, rear.
11. Discharge valve assembly - front, rear.
12. Gasket service kit - containing all gaskets, seals, O-rings, etc.
13. Shaft seal kit.
14. Nuts - head to shell and shaft.
15. Retainer rings.
16. Cylinder locator pins.
17. Valve and head locator pins.
18. Service type discharge cross-over tube kit. All service parts are protected by a preservation process and packaged in a manner that will eliminate the necessity of cleaning, washing or flushing of parts to remove preservation materials. Parts can be used just as they are removed from service package.

Certain parts are identified on the piece part to denote their size or dimension. This applies to piston shoe discs and shaft thrust races.

Gasket service kit contains shaft seal O-ring, head to shell O-rings, oil tube inlet O-ring, and discharge cross-over tube O-ring. This kit should be used to replace all seals and gaskets whenever a compressor is overhauled or an individual component is replaced.

There is an optional method of handling one of the major internal components -- the cylinder assembly. A service cylinder assembly, including bearings, and both front and rear halves of cylinders mated together, is available for service.

There may be occasions where it would be desirable to use this assembly rather than the complete internal assembly. In case it is used, the gaging and parts selection operations will have to be performed as described in Note 37.

An inspection should be made of the internal mechanism assembly to determine if any service operations should be performed. A detailed inspection of parts should be made to determine if it is economically feasible to replace them.

Before proceeding with disassembly, wipe exterior surface of compressor clean.

All oil in compressor should be drained and measured. Assist draining by positioning compressor with oil drain plug down, open suction connector and rotate drive shaft several times.

35. Compressor Internal Mechanism Removal

1. Remove clutch plate and hub assembly as described in Note 29a.
2. Remove pulley and bearing assembly as described in Note 30a.
3. Remove clutch coil and housing assembly as described in Note 32a.
4. Remove shaft seal as described in Note 33a.

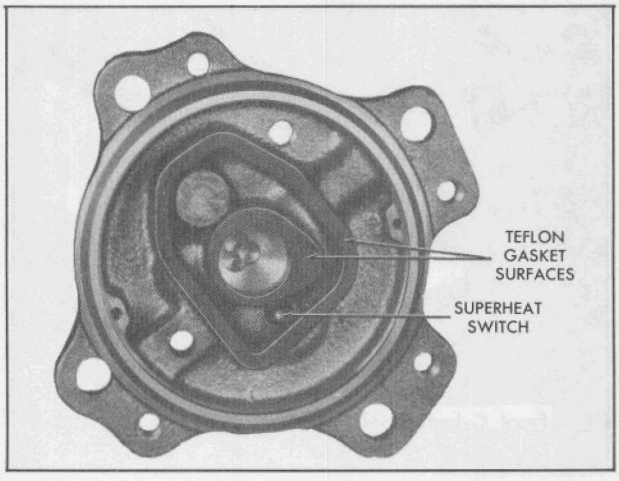


Fig. 1-73 Teflon Gasket Surfaces on Rear Head

5. Invert compressor and Holding Fixture, J-9396, with front end of compressor shaft down.

(NOTE: Additional oil may leak from compressor at this time. All oil must be drained into a container so that total amount can be measured. A liquid measuring cup may be used for this purpose. Drained oil should then be discarded.)

6. Remove four locknuts from threaded studs on compressor shell and remove rear head.

(NOTE: Tap uniformly around rear head if head is binding.)

7. Wipe excess oil from all teflon gasket surfaces on rear head casting webs, and examine gasket surfaces, Fig. 1-73. If any damage is observed, head should be replaced.

8. Remove suction screen and examine for any damage or contamination. Clean or replace if necessary.

9. Paint an identifying mark (prussian blue or other suitable marking material may be used) on exposed face of inner and outer oil pump gears and then remove gears.

(NOTE: Identifying marks are to assure that gears, if reused, will be installed on identical position.)

10. Remove and discard rear head to shell O-ring.

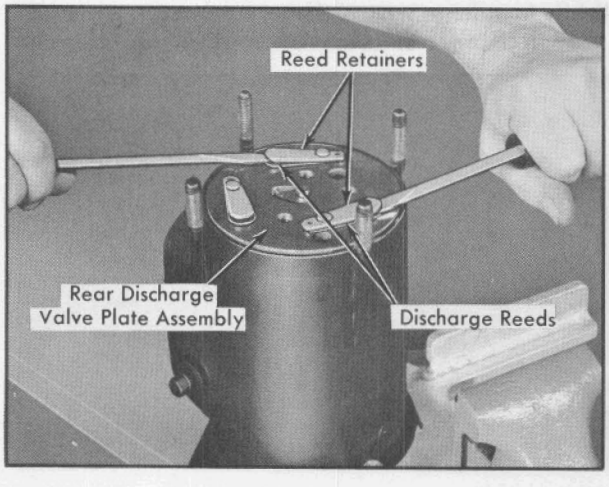


Fig. 1-74 Removing Rear Discharge Valve Plate

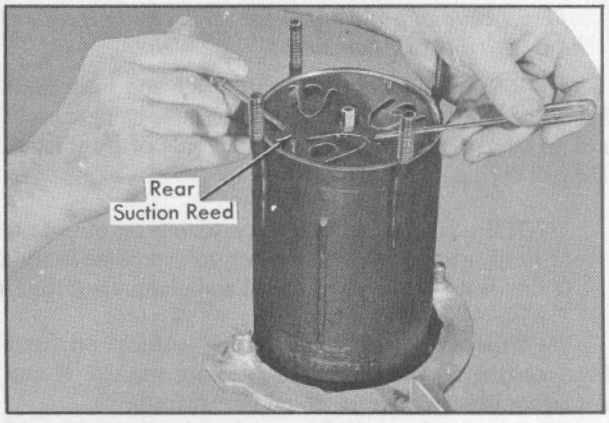


Fig. 1-75 Removing Rear Suction Reed

11. Carefully remove rear discharge valve plate assembly. Use two small screwdrivers under reed retainers and pry up on assembly, Fig. 1-74. Do not position screwdrivers between reeds and reed seats.

12. Examine valve reeds and seats. Replace entire assembly if any reeds or seats are damaged.

13. Using two small screwdrivers, carefully remove rear suction reed, Fig. 1-75. Do not pry up on horseshoe shaped reed valves.

14. Examine reeds for damage, and replace if necessary.

15. Using Oil Pick-Up Tube Remover, J-5139, Fig. 1-76 remove oil pick-up tube. Remove O-ring from oil inlet.

16. Loosen compressor from Holding Fixture, place Internal Assembly Support Block, J-9521, over oil pump shaft and, holding Support Block in position with one hand, lift compressor from Holding Fixture with other hand. Invert compressor and position on bench with Internal Assembly Support Block resting on bench.

17. Lift front head and compressor shell assembly up, leaving internal mechanism resting on Internal Assembly Support Block.

CAUTION: Do not tap on end of compressor shaft to remove internal mechanism. If mechanism

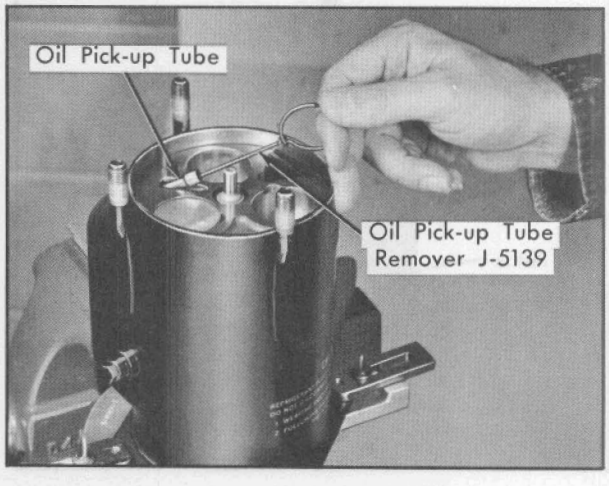


Fig. 1-76 Removing Oil Pick-Up Tube

will not slide out of compressor shell, tap on front head with a plastic hammer.

18. Rest compressor shell on its side and push front head assembly through compressor shell, being careful not to damage sealing areas on inner side of front head. Discard O-ring.

(NOTE: It may be necessary to tap on outside of front head, using a plastic hammer, to overcome friction of O-ring seal between front head and compressor shell.)

19. Wipe excess oil from sealing surfaces on front head casting webs and examine sealing surface. If any damage is observed, head should be replaced.

20. Remove front discharge valve plate assembly and front suction reed plate. Examine reeds and seats. Replace necessary parts.

21. Remove suction cross-over cover by prying with screwdriver between cylinder casting and cover.

(NOTE: Examine internal mechanism for any obvious damage. If internal mechanism has sustained major damage, due to loss of refrigerant or oil, it may be necessary to use the service internal mechanism assembly rather than replace individual parts.)

36. Compressor Internal Mechanism Disassembly

Use Parts Tray, J-9402, to retain compressor parts during disassembly.

1. Remove internal mechanism from compressor as described in Note 35.

2. Identify by pencil mark, or some other suitable means, each piston numbering them 1, 2, and 3, Fig. 1-77. Number the piston bores in the front cylinder half in like manner so that pistons can be replaced in their original locations.

3. Separate cylinder halves, using a wood block and mallet, Fig. 1-78. Make certain that discharge cross-over tube does not contact swash plate when separating cylinder halves.

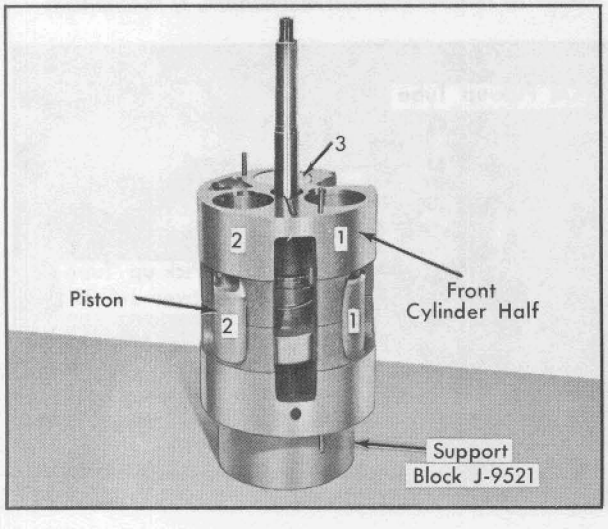


Fig. 1-77 Numbering Piston And Cylinder Bores

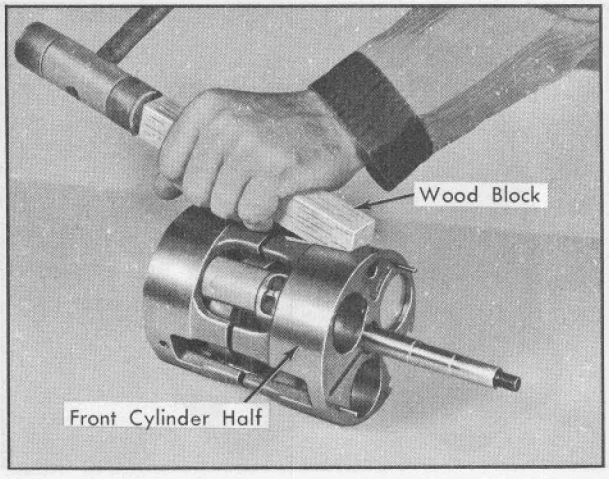


Fig. 1-78 Separating Cylinder Halfs

CAUTION: Under no circumstances should shaft be struck at either end in an effort to separate upper and lower cylinder halves.

4. Position complete internal mechanism, rear cylinder down, on Support Block, J-9521, and remove front cylinder half.

5. Pull up on compressor shaft and remove piston previously identified as #1, with balls and shoe discs, from swash plate.

6. Remove and discard piston shoe discs.

7. Remove and examine piston balls, and if satisfactory for re-use, place balls in #1 compartment of Parts Tray.

8. Remove piston rings and examine for re-use. If satisfactory, place in proper slots below #1 piston in Parts Tray.

9. Place piston in #1 compartment of Parts Tray with notch in casting web at front end of piston in dimpled groove of compartment, Fig. 1-79.

10. Repeat steps 5 through 9 for pistons #2 and #3.

11. Remove front combination of thrust races and thrust bearing from shaft, Fig. 1-80. Discard races and place bearing in front bearing slot of Parts Tray.

12. Remove shaft assembly from rear cylinder half. It may be necessary to bend discharge cross-over tube slightly in order to remove shaft.

13. Remove rear combination of thrust races and

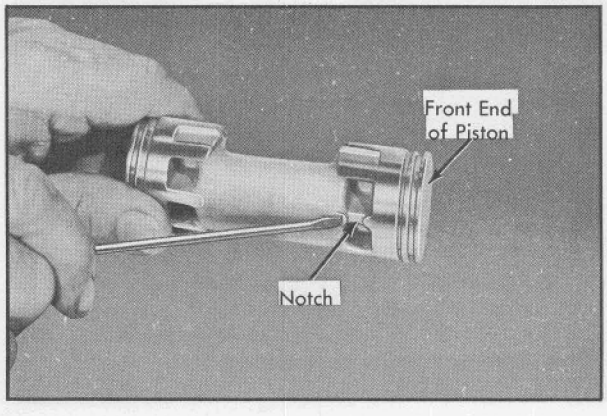


Fig. 1-79 Compressor Piston

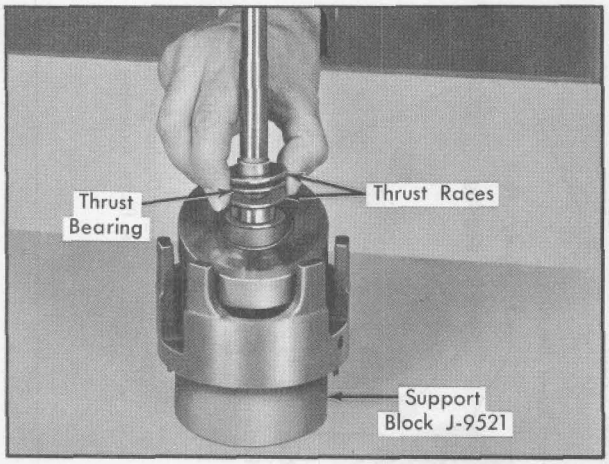


Fig. 1-80 Removing Front Thrust Races and Bearing

bearing from shaft. Discard races and place bearing in rear bearing slot in Parts Tray.

14. Examine surface of swash plate and shaft. Replace as an assembly, if necessary. Examine front and rear thrust bearings and replace if necessary.

(NOTE: A certain amount of shoe disc wear on swash plate is normal as well as some markings indicating load of needle bearings on shaft.)

15. Remove discharge cross-over tube from cylinder half, using self clamping pliers.

(NOTE: This is necessary only on original factory equipment as ends of the tube are swedged into cylinder halves. The discharge cross-over tube in internal mechanism assemblies that have been previously serviced have an O-ring and bushing at each end of the tube, and can be easily removed by hand.)

16. Examine piston bores and needle bearings in front and rear cylinder halves. Replace front and rear cylinders if any cylinder bore is deeply scored or damaged.

17. Needle bearings may be removed if necessary by driving them out with special Thin Wall Socket, J-9399. Insert socket in hub end (inner side) of cylinder head and drive bearing out. To install needle bearing, place cylinder half on Support Block, and insert bearing in end of cylinder head with bearing identification marks up. Use Needle Bearing Installer, J-9432, and drive bearing into cylinder head, Fig. 1-81, until tool bottoms on cylinder face.

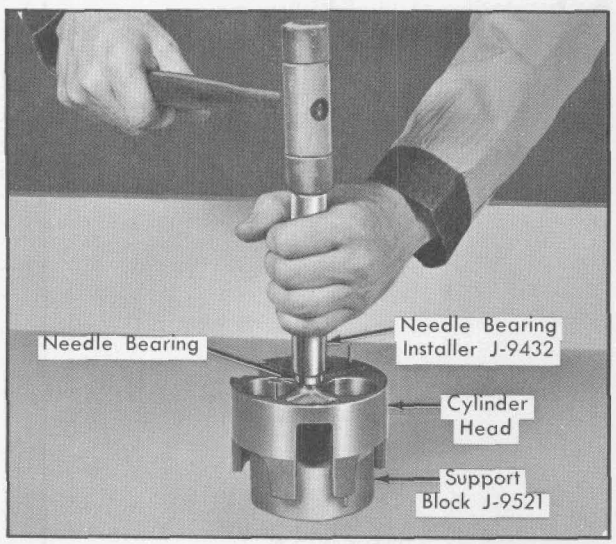


Fig. 1-81 Installing Needle Bearings

18. Wash all parts to be re-used with trichloroethylene, alcohol, or a similar solvent. Air dry parts using a source of clean dry air.

(NOTE: Compressor internal components may be identified by referring to Fig. 1-82.)

37. Compressor Internal Mechanism Gaging Operation

1. Install Compressing Fixture, J-9397, on Holding Fixture, J-9396, in vise. Place front cylinder half in Compressing Fixture, flat side down. Front cylinder half has long slot extending out from shaft hole.

2. Secure from service parts stock four zero thrust races and three zero shoe discs.

3. Install a zero thrust race, thrust bearing, and a second zero thrust race on front end of compressor shaft. Lubricate races and bearing with petrolatum.

4. Insert threaded end of shaft through needle bearing in front cylinder half, and allow thrust race and bearing assembly to rest on hub of cylinder.

5. Install a zero thrust race on rear end of compressor shaft so that it rests on hub of swash plate. Then install thrust bearing and a second zero thrust race, Fig. 1-80. Lubricate races and bearing with petrolatum.

6. Lubricate ball pockets of the #1 piston with refrigeration oil and place a ball in each socket. Use balls previously removed if they are to be re-used.

7. Lubricate cavity of a zero shoe disc with refrigeration oil and place shoe disc over ball in front end of piston, Fig. 1-84. Front end of piston has an identifying notch in casting web. Piston rings should not be installed at this time.

(NOTE: Shoe discs should not be installed on rear piston balls during gaging operation.)

8. Rotate shaft and swash plate until high point of swash plate is over #1 piston cylinder bore.

9. Lift shaft assembly and hold front thrust race and bearing assembly against swash plate hub.

10. Position piston over #1 cylinder bore (notched end of piston on bottom and piston straddling swash plate) and lower the shaft to allow piston to drop into its bore, Fig. 1-85.

11. Repeat steps 6 through 10 for pistons #2 and #3.

12. Install rear cylinder half on pistons, aligning cylinder with discharge cross-over tube hole in front cylinder. Tap into place using a plastic mallet.

13. Position discharge cross-over tube holes between a pair of Compressing Fixture bolts to permit access for feeler gage.

14. Install top plate on Compressing Fixture, J-9397.

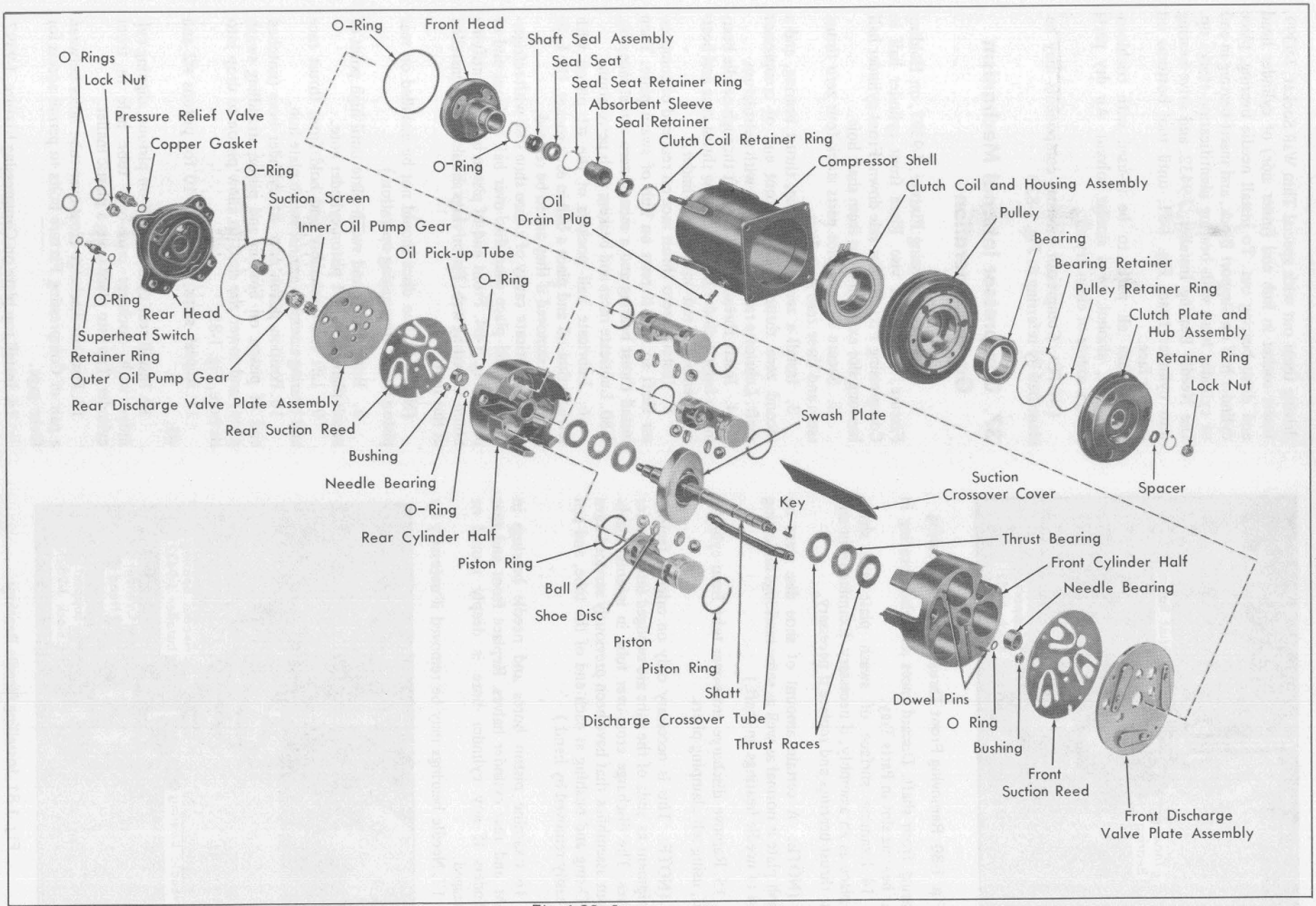


Fig. 1-82 Compressor Disassembled

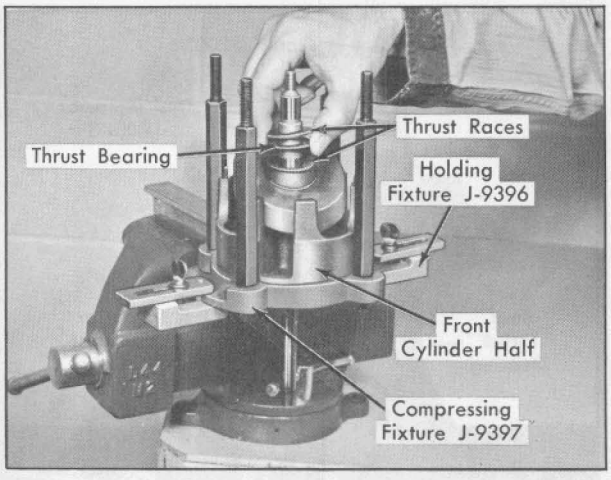


Fig. 1-83 Installing Rear Thrust Races and Bearing

Tighten nuts to 15 foot-pounds torque using a 0-25 foot-pounds torque wrench.

15. Measure clearance between rear ball of #1 piston and swash plate, in following manner:

a. Select a suitable combination of well-oiled feeler gage leaves to fit snugly between ball and swash plate.

b. Attach a spring scale reading in 1 ounce increments to the feeler gage. A distributor point checking scale or Spring Scale, J-544 may be used.

c. Pull on spring scale to slide feeler gage stock out from between ball and swash plate, and note reading on spring scale as feeler gage is removed, Fig. 1-86. Reading should be between 4 and 8 ounces.

d. If reading in step (c) is under 4 or over 8 ounces, reduce or increase thickness of feeler gage leaves and repeat steps (a) through (c) until a reading of 4 to 8 ounces is obtained. Record clearance between ball and swash plate that results in a 4 to 8 ounce pull on spring scale.

16. Rotate shaft 120° and repeat step 15 between same ball and swash plate. Record this measurement.

17. Rotate shaft 120° and again repeat step 15 between these same parts and record measurements.

18. Select a numbered shoe disc corresponding to minimum feeler gage reading recorded in the three checks. Place shoe discs in Parts Tray, in compartment corresponding to piston #1 and rear ball pocket position.

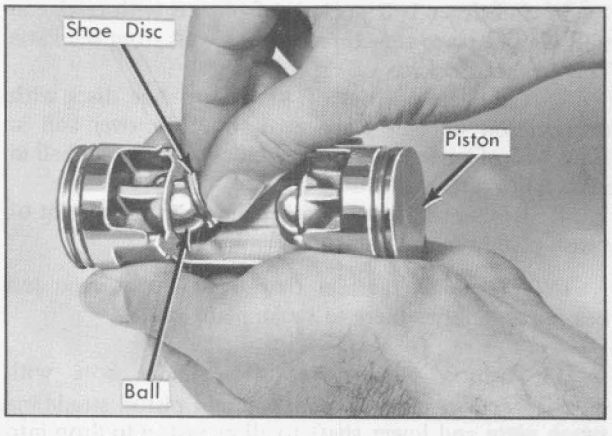


Fig. 1-84 Installing Shoe Disc

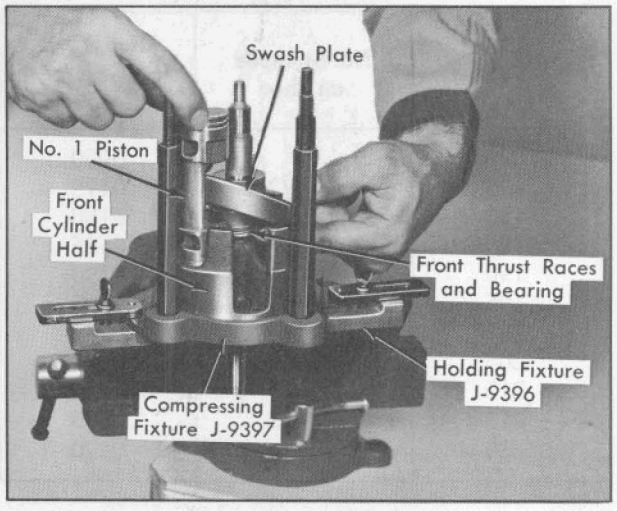


Fig. 1-85 Installing Piston

(NOTE: Shoe discs are provided in .0005 inch (one-half thousandths) variations. There are a total of eleven sizes available for field servicing. All shoe discs are marked with the shoe size, which corresponds to the last three digits of the piece part number. See shoe disc size chart.)

Once proper selection of shoe has been made, the matched combination of shoe disc to rear ball and spherical cavity in piston must be kept in proper relationship during disassembly after gaging operation, and during final assembly of internal mechanism.

19. Repeat in detail the same gaging operation outlined in steps 15 through 18 for pistons #2 and #3.

20. Mount Dial Indicator, J-8001-3, on edge of Compressing Fixture with Clamp, J-8001-1, and Sleeve, J-8001-2, Fig. 1-87. Position Dial Indicator on rear end of shaft and adjust to zero. Push front end of shaft upward and record measurement.

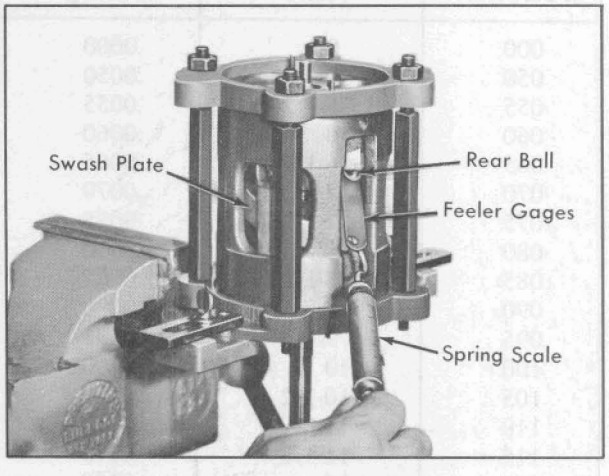


Fig. 1-86 Gaging Rear Piston Ball

Last 3 Digits of Part No.	No. Stamped on Shoe	Min. Feeler Gage Reading
000	0	.0000
175	17-1/2	.0175
180	18	.0180
185	18-1/2	.0185
190	19	.0190
195	19-1/2	.0195
200	20	.0200
205	20-1/2	.0205
210	21	.0210
215	21-1/2	.0215
220	22	.0220

(NOTE: Dial Indicator increments are .001 inch; therefore, reading must be estimated to nearest .0005 inch.)

21. Select a thrust race with a number corresponding to the amount of end play shown. Place thrust race in right hand slot at bottom center of Parts Tray.

(NOTE: Fifteen thrust races are provided in increments of .0005 inch (one-half thousandths) thickness and one zero gage thickness providing a total of 16 sizes available for field service. Thrust races are identified on the part by their thickness in thousands in excess of the thickness of the zero thrust race.)

This number also corresponds to the last three digits of the piece part number. See thrust race size chart.

A tolerance of .0005 inch to .0015 inch is built into thrust races to provide a running clearance between hub surfaces of swash plate and front and rear hubs of cylinder.

22. Remove nuts from top plate of Compressing Fixture, and remove top plate.

THRUST RACE SIZE CHART

Last 3 Digits of Part No.	No. Stamped on Thrust Race	Dial Indicator Reading
000	0	.0000
050	5	.0050
055	5-1/2	.0055
060	6	.0060
065	6-1/2	.0065
070	7	.0070
075	7-1/2	.0075
080	8	.0080
085	8-1/2	.0085
090	9	.0090
095	9-1/2	.0095
100	10	.0100
105	10-1/2	.0105
110	11	.0110
115	11-1/2	.0115
120	12	.0120

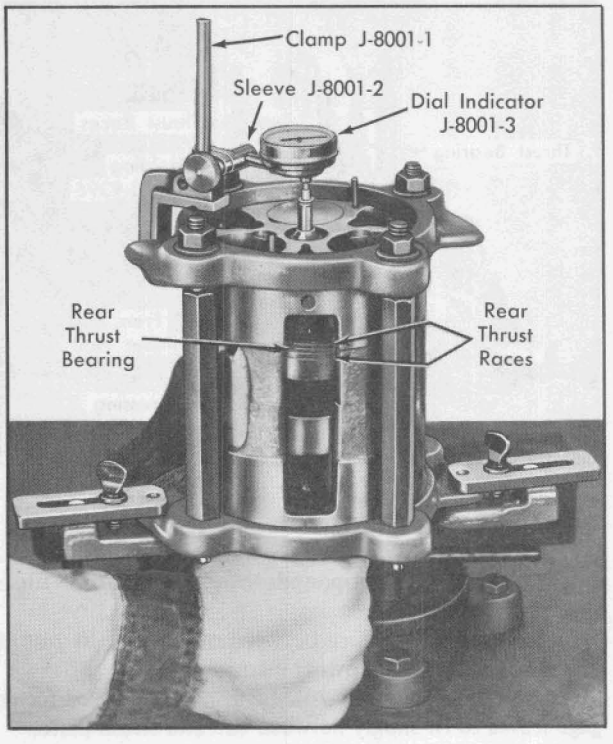


Fig. 1-87 Gaging Rear Thrust Race

23. Separate cylinder halves while unit is in fixture. It may be necessary to use a wood block and mallet.

24. Remove rear cylinder half and carefully remove one piston at a time from swash plate and front cylinder half. Do not lose the relationship of the front ball and shoe disc and rear ball. Transfer each piston, ball, and shoe disc to its proper place in Parts Tray.

25. Remove rear outer zero thrust race from shaft and install thrust race previously selected.

(NOTE: The zero thrust race may be put aside for re-use in additional gaging or rebuilding operations.)

38. Compressor Internal Mechanism Assembly

1. Install a piston ring on each end of #1 piston, with scraper groove toward center of piston.

2. Lubricate ball pockets of pistons with refrigeration oil and place the corresponding balls from the Parts Tray in each pocket.

3. Lubricate cavities of #1 piston shoe discs with refrigeration oil and place zero shoe disc over ball in front end of piston and numbered shoe disc over ball in rear end of piston.

4. Rotate shaft and swash plate until high point of swash plate is over #1 piston cylinder bore.

(NOTE: Make certain that front thrust race and bearing assembly adhere to swash plate hub.)

5. Position piston over #1 cylinder bore with notched end of piston on bottom and piston straddling swash plate and lower shaft to allow piston to drop into its bore.

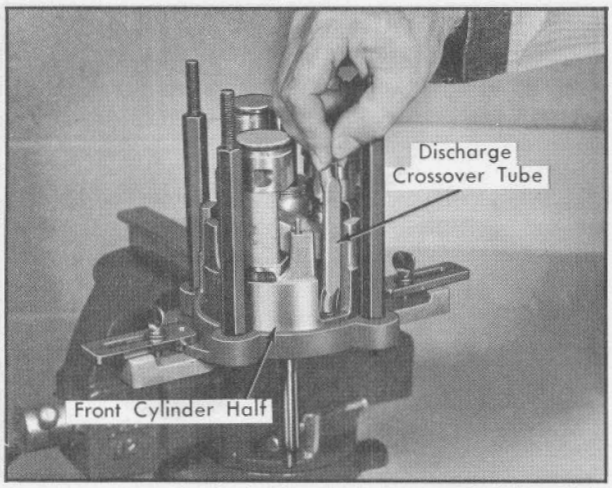


Fig. 1-88 Installing Discharge Crossover Tube

6. Position piston ring gap toward shaft, compress ring and lower ring into front cylinder half.

7. Repeat steps 1 through 6 for pistons #2 and #3.

8. Install new discharge cross-over tube in front cylinder half with bridged surface facing outboard, Fig. 1-88. Make certain that end of tube is properly centered in hole in front cylinder half.

(NOTE: The service discharge cross-over tube is similar to the production type tube except that an O-ring and bushing is used at each end, Fig. 1-89. Do not install O-ring or bushing at this time.)

9. Rotate shaft to position pistons in a stairstep arrangement. Position rings on each piston so that ring gaps are toward shaft, then push rings as far outboard as possible.

10. Place rear cylinder half over shaft and start pistons and rings into cylinder bores.

11. When all three pistons and rings are in their respective bores, align end of discharge cross-over tube with hole in rear cylinder half. Make certain that bridged surface of tube faces outboard for swash plate clearance.

12. When satisfied that all parts are in proper alignment, tap rear cylinder half with a mallet to seat it over the locating dowel pins.

13. Remove internal mechanism from fixture and place on bench.

14. Bending suction cross-over cover slightly, start it into one end of dove tail slot in cylinder halves. Align cover with ends of cylinder faces by gently tapping end of cover with a plastic hammer.

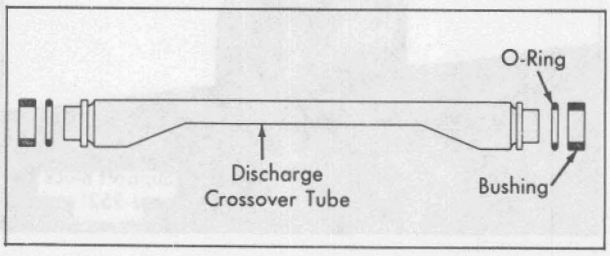


Fig. 1-89 Service Type Crossover Tube



Fig. 1-90 Installing O-Ring on Crossover Tube

39. Compressor Internal Mechanism Installation

1. Place internal mechanism on Internal Assembly Support Block J-9521, with rear end of shaft in block hole.

2. Install new O-ring and bushing on front end of discharge cross-over tube, Fig. 1-90. The O-ring and bushing are service parts only for internal mechanisms that have been disassembled in the field.

3. Install new dowel pins in front cylinder half, if previously removed.

4. Install front suction reed plate on front cylinder half. Align with dowel pins, suction ports, oil return slot, and discharge cross-over tube, Fig. 1-91.

5. Install front discharge valve plate assembly, aligning holes with dowel pins and proper openings in front suction reed plate, Fig. 1-92.

(NOTE: Front discharge plate has a large diameter hole in the center, Fig. 1-93.)

6. Coat gasket sealing surfaces on webs of compressor front head casting with 525 viscosity refrigeration oil.

7. Determine exact position of front head casting in relation to dowel pins on internal mechanism. Mark position of dowel pins on sides of front head assembly and on sides of internal mechanism with a grease pencil. Carefully lower front head casting into position, Fig. 1-94, making certain that sealing area around center bore of head assembly does not contact shaft as head assembly is lowered. Do not rotate head assembly to line up with dowel pins, as sealing areas would contact reed retainers.

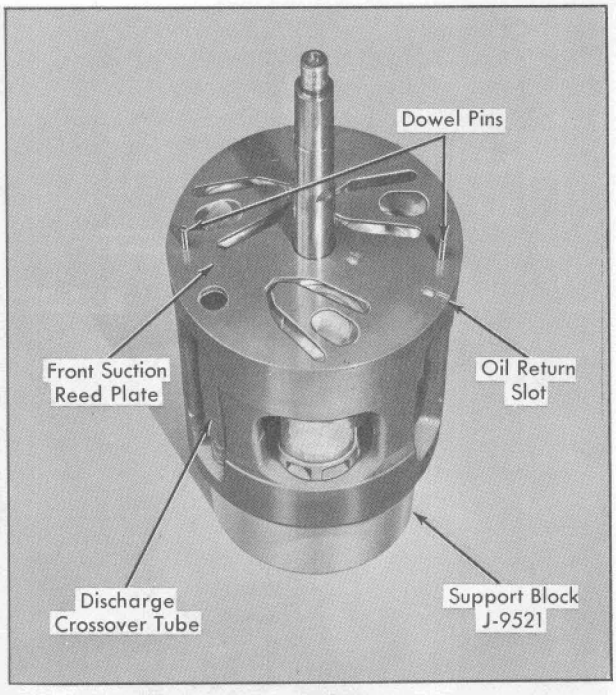


Fig. 1-91 Installing Front Suction Reed

8. Generously lubricate angled groove at lower edge of front head casting with 525 viscosity refrigeration oil and install new O-ring in groove, Fig. 1-95.

9. Coat inside machine surfaces of compressor shell with 525 viscosity refrigeration oil and position shell on internal mechanism, resting on O-ring seal.

10. Using flat side of a small screwdriver, gently press O-ring in around circumference of internal mechanism until compressor shell slides down over internal mechanism. As shell slides down, line up oil sump with oil intake tube hole, Fig. 1-96.

11. Holding support block, invert assembly and place

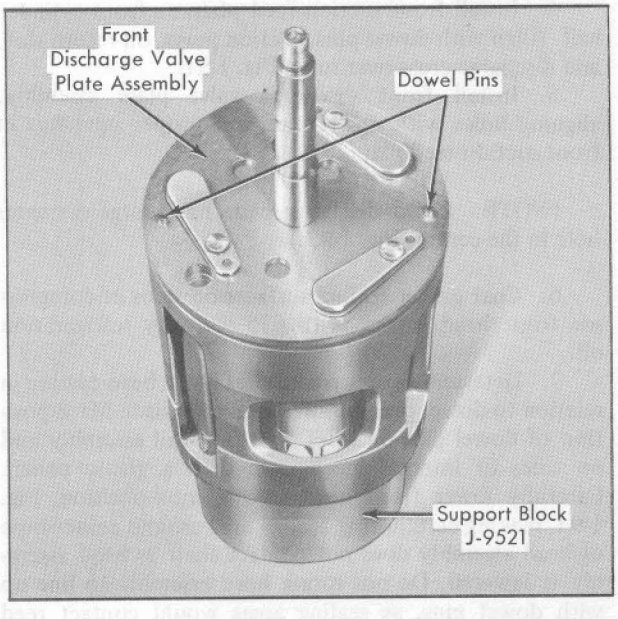


Fig. 1-92 Installing Front Discharge Valve Plate

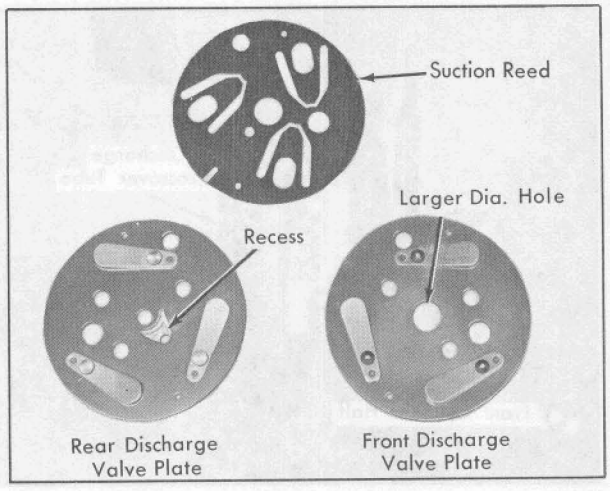


Fig. 1-93 Front and Rear Discharge Valve Plates

in holding fixture with front end of shaft down. Remove support block.

12. Install new dowel pins in rear cylinder half if previously removed.

13. Install new O-ring in oil pick-up tube cavity.

14. Lubricate oil pick-up tube and install in cavity, rotating compressor mechanism to align tube with hole in shell baffle, Fig. 1-97.

15. Install new O-ring and bushing on rear of discharge cross-over tube.

16. Install rear suction reed over dowel pins with slot toward sump.

17. Install rear discharge valve plate assembly over dowel pins with reed retainers up.

18. Position inner oil pump gear over shaft with previously applied identification mark up.

19. Position outer oil pump gear over inner gear with previously applied identification mark up and, when standing facing oil sump, position outer gear so that it meshes with inner gear at the 9 o'clock position and

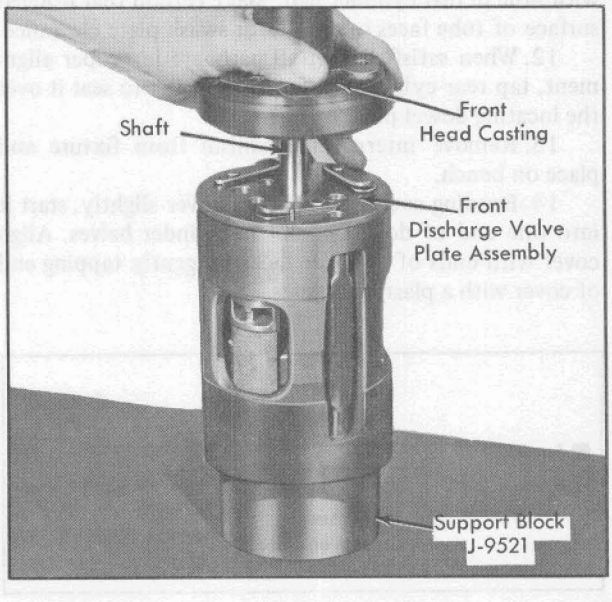


Fig. 1-94 Installing Front Head Casting

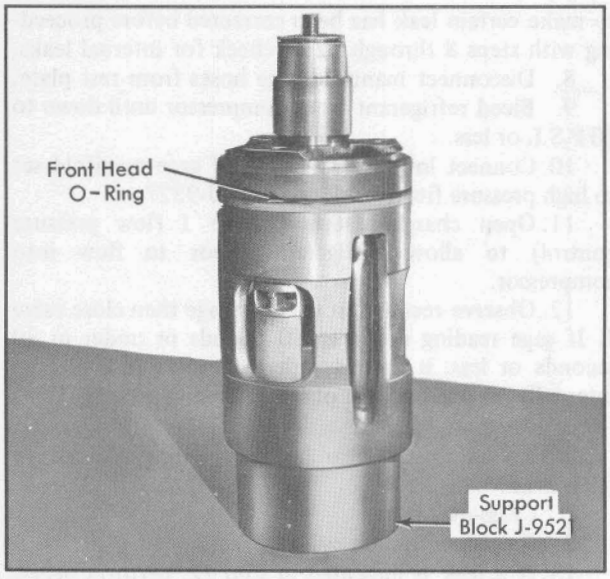


Fig. 1-95 Front Head O-Ring Installed

cavity between gear teeth is at 3 o'clock position, Fig. 1-98.

20. Generously oil rear discharge valve plate assembly around outer edge where large diameter O-ring will be placed. Oil valve reeds, pump gears, and area where teflon sealing surface will contact rear discharge valve plate.

21. Lubricate new head to-shell O-ring and install on rear discharge valve plate, in contact with shell.

22. Install suction screen in rear head casting, using care not to damage screen.

23. Coat teflon sealing surface on webs of compressor rear head casting with 525 viscosity refrigeration oil.

24. Install rear head assembly over studs on compressor shell. The two lower threaded compressor mounting holes should be in alignment with the compressor sump.

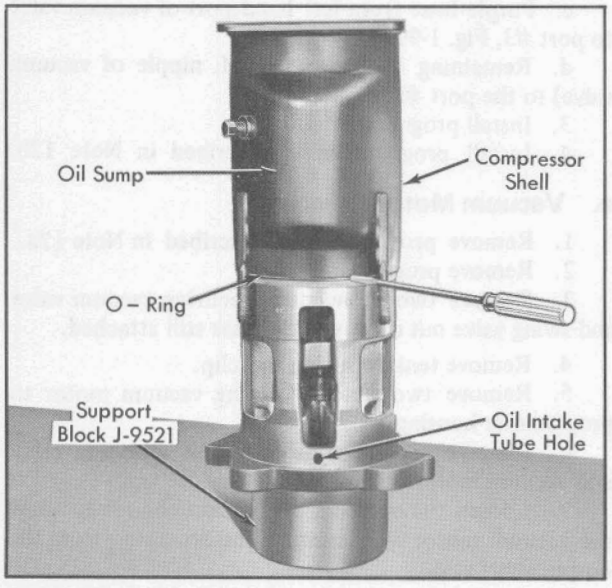


Fig. 1-96 Installing Compressor Shell

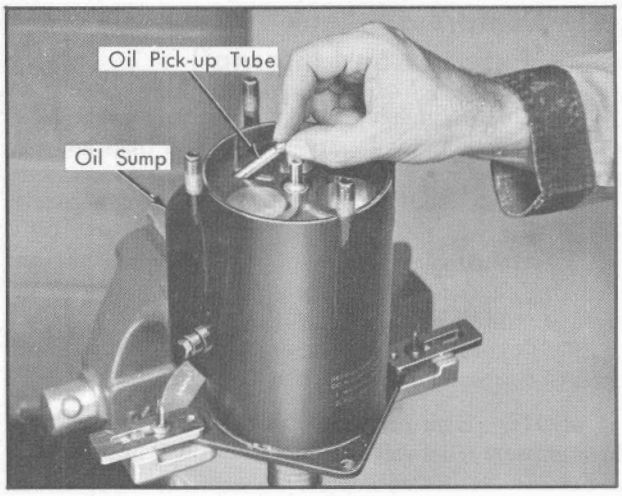


Fig. 1-97 Installing Oil Pick-up Tube

Make certain that suction screen does not drop out of place when lowering rear head into position.

(NOTE: If rear head assembly will not slide down over dowels in internal mechanism, twist front head assembly back and forth very slightly by hand until rear head drops over dowel pins.)

25. Install nuts on threaded shell studs and tighten evenly to 20 foot-pounds torque using a 0-25 foot-pounds torque wrench.

26. Invert compressor in holding fixture and install shaft seal as described in Note 33b.

27. Install compressor clutch coil and housing assembly as described in Note 32b.

28. Install compressor pulley and bearing assembly as described in Note 30b.

29. Install compressor clutch plate and hub assembly as described in Note 29b.

30. Add 525 viscosity refrigeration oil as described in Note f.

31. Check for external and internal leaks as described in Note 40.

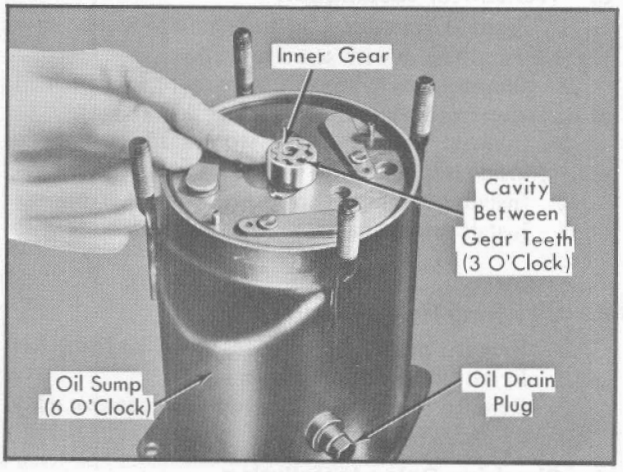


Fig. 1-98 Positioning Oil Pump Gears

40. Compressor Leak Testing (External and Internal)

1. Rotate clutch hub clockwise several turns to pick oil up from sump and carry it to piston rings and oil seals.
2. Install Test Plate, J-9527, on rear head of compressor.
3. Attach center hose of gage manifold set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.
4. Connect charging station high and low pressure lines to corresponding fittings on Test Plate.

(NOTE: High pressure fitting is one farthest from high pressure relief valve on compressor rear head.)

5. Open valve 1 (low pressure control), valve 2 (high pressure control), and valve 4 on Charging Station to allow refrigerant vapor to flow into compressor.
6. Using Leak Detector Torch, J-6084, check for leaks at pressure relief valve, oil drain fitting, compressor rear head seal, compressor front head seal and compressor shaft seal. After checking, shut off valve 1 and valve 2 on Charging Station.
7. If an external leak is present, perform the necessary corrective procedures and repeat steps 1 through 6 to make certain leak has been corrected before proceeding with steps 8 through 12 to check for internal leaks.
8. Disconnect manifold gage hoses from test plate.
9. Bleed refrigerant from compressor until down to 10 P.S.I. or less.
10. Connect low pressure hose of gage manifold set to high pressure fitting on Test Plate, J-9527.
11. Open charging station valve 1 (low pressure control) to allow refrigerant vapor to flow into compressor.
12. Observe reading on pressure gage then close valve 1. If gage reading drops to 10 pounds or under in 30 seconds or less, it indicates that compressor is leaking internally, at one or more of the following points:
    a. Reed valves.
    b. Teflon seals at rear head, or sealing surfaces on front head.
    c. Cross-over tube.
    d. Raised section on cylinder face.
13. If a leak is indicated in step 12, perform necessary corrective procedures to eliminate internal leak and repeat steps 1 through 12 to make certain external and internal leaks are corrected. If no leak was indicated, proceed with step 14.
14. Disconnect charging station from test plate.
15. Remove test plate from compressor.

PROGRAMMER OVERHAUL

41. Programmer Disassembly

a. Transducer Removal

1. Remove programmer as described in Note 12a.
2. Remove programmer cover.
3. Disconnect transducer electrical leads at transducer.
4. Remove vacuum hoses from transducer vacuum ports.
5. Remove screw with clip holding transducer in place and remove transducer.

b. Transducer Installation

1. Position transducer in programmer as shown in Fig. 1-99 and secure with screw and clip.
2. Connect black vacuum hose to top port (small) of transducer and white hose to lower port (large).
3. Connect electrical leads to transducer: yellow wire to inside terminal; gray wire to outside terminal.
4. Install programmer cover.
5. Install programmer as described in Note 12b.

c. Checking Relay Removal

1. Remove programmer as described in Note 12a.
2. Remove programmer cover.
3. Remove four hoses from relay and remove relay.

d. Checking Relay Installation

1. Position checking relay in programmer with ports 1 and 2 towards vacuum motor as shown in Fig. 1-99.
2. Make the following vacuum hose connections:
    a. White hose from transducer wraps around vacuum motor and connects to port #2, Fig. 1-99.

(NOTE: If this vacuum hose is replaced, the replacement hose must be at least 15" long).

    b. Short (yellow) hose connects remaining port (#1) to vacuum motor, Fig. 1-99.
    c. Purple hose from left hand port of vacuum valve to port #3, Fig. 1-99.
    d. Remaining black hose (R.H. nipple of vacuum valve) to the port #5, Fig. 1-99.
3. Install programmer cover.
4. Install programmer as described in Note 12b.

e. Vacuum Motor Removal

1. Remove programmer as described in Note 12a.
2. Remove programmer cover.
3. Remove two screw/studs securing vacuum valve and swing valve out of way with hoses still attached.
4. Remove tension spring and clip.
5. Remove two screws securing vacuum motor to programmer housing.
6. Remove vacuum hose between checking relay and vacuum motor.
7. Loosen the output shaft bracket enough to allow the vacuum motor mechanism to be separated from the output shaft arm.
8. Remove vacuum motor with blower contact assembly remaining on circuit board.

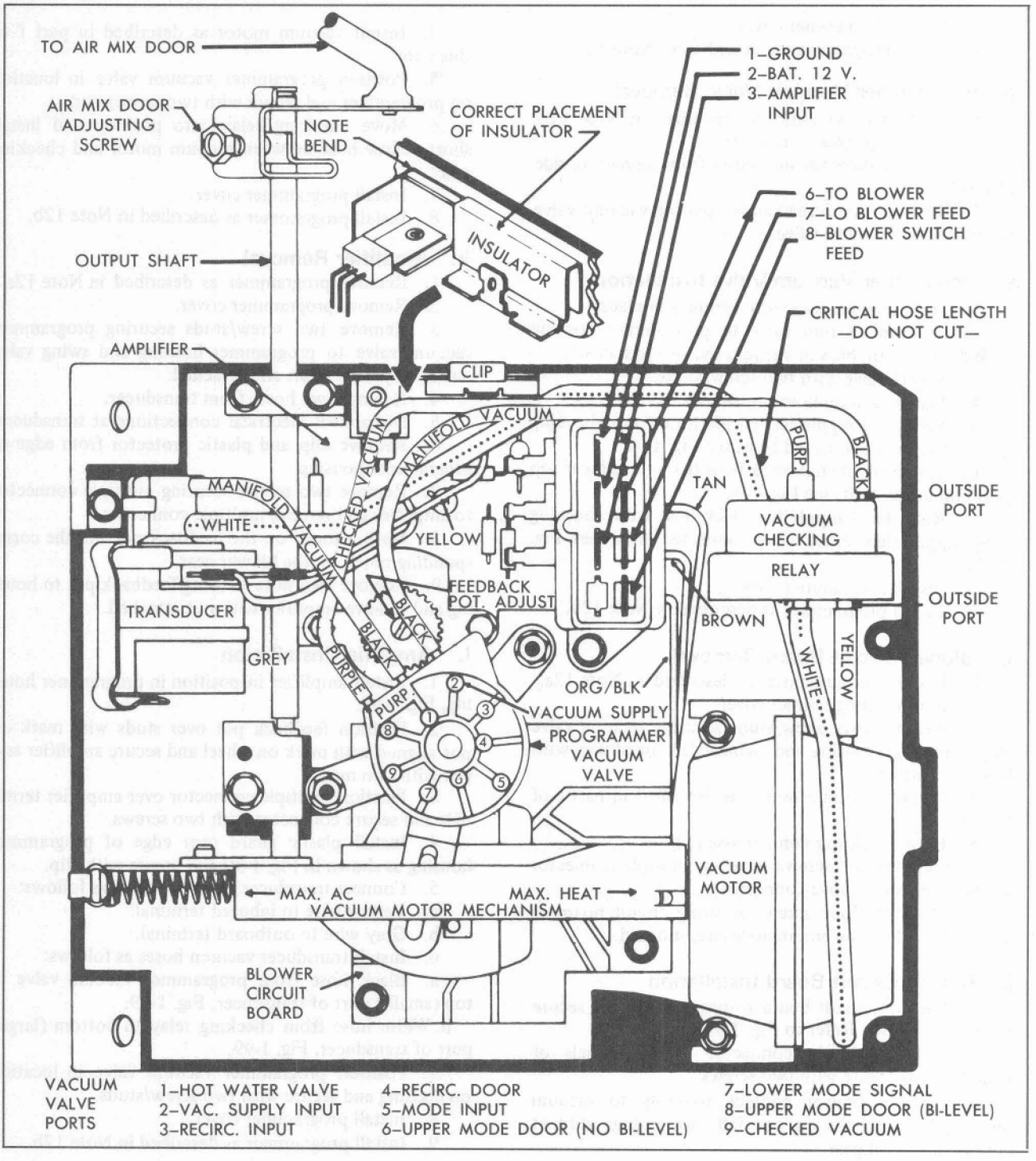


Fig. 1-99 ATC Programmer

(NOTE: Handle blower contact assembly carefully as detent balls may fall out. If blower contact assembly is removed, mark a tooth on the feedback pot and a corresponding notch on blower switch gear.)

f. Vacuum Motor Installation

1. If blower contact assembly was removed, position blower contact assembly to vacuum motor. Use care to be sure that balls do not fall out. Engage stud of contact in slot of gear.

2. Align marks on feedback pot and blower contact gear and position vacuum motor to programmer housing.

3. With vacuum motor mechanism in position on output shaft arm, tighten retaining screw on output shaft bracket.

4. Secure vacuum motor in position with two screws.

5. Install programmer vacuum valve in position and secure with two screw/studs.

6. Install spring between vacuum motor arm and clip around outside edge of housing.

7. Install short vacuum hose (yellow) between vacuum motor and checking relay.

8. Install programmer cover.
9. Install programmer as described in Note 12b.

g. Programmer Vacuum Valve Removal

1. Remove programmer as described in Note 12a.
2. Remove programmer cover.
3. Remove three vacuum hoses from nipples on side of valve.
4. Remove two screw/studs securing vacuum valve to housing and remove valve.

h. Programmer Vacuum Valve Installation

1. Make sure vacuum valve spring is in place.
2. Position vacuum valve to programmer housing with drive arm on boss of vacuum motor mechanism.
3. Secure valve with two screw/studs.
4. Install vacuum hoses as follows:

a. Left hand nipple has purple hose from checking relay lower port connected to it, see Fig. 1-99.

b. Center nipple has black hose from transducer top port connected to it, see Fig. 1-99.

c. Right hand nipple has black hose from checking relay upper right hand port connected to it, see Fig. 1-99.

5. Install programmer cover.
6. Install programmer as described in Note 12b.

i. Blower Circuit Board Removal

1. Remove programmer as described in Note 12a.
2. Remove programmer cover.
3. Remove two screw/studs securing vacuum valve to programmer housing and swing valve out of way with hoses still attached.
4. Remove vacuum motor as described in part e of this note.
5. Remove blower contact assembly.
6. Remove two screws securing multiple connector at amplifier and remove connector.
7. Remove three screws securing circuit board to programmer housing and remove circuit board.

j. Blower Circuit Board Installation

1. Position circuit board to programmer and secure with three screws. Refer to Fig. 1-99.
2. Install multiple connector over terminals of amplifier and secure with two screws.
3. Position blower contact assembly to vacuum motor. Be sure balls do not fall out. Engage stud of contact in slot of gear.
4. Install vacuum motor as described in part f of this note.
5. Position programmer vacuum valve in location on programmer and secure with two screw/studs.
6. Move checking relay into position and install short yellow hose between vacuum motor and checking relay.
7. Install programmer cover.
8. Install programmer as described in Note 12b.

k. Amplifier Removal

1. Remove programmer as described in Note 12a.
2. Remove programmer cover.
3. Remove two screw/studs securing programmer vacuum valve to programmer housing and swing valve out of way with hoses still attached.
4. Remove two hoses from transducer.
5. Disconnect electrical connections at transducer.
6. Remove clip and plastic protector from edge of programmer housing.
7. Remove two screws securing multiple connector to amplifier and remove multiple connector.
8. Mark a tooth on the feedback pot and the corresponding notch on the blower gear.
9. Remove two nuts securing feedback pot to housing and remove amplifier with pot attached.

l. Amplifier Installation

1. Install amplifier in position in programmer housing, Fig. 1-99.
2. Position feedback pot over studs with mark on pot aligned with mark on wheel and secure amplifier and pot with two nuts.
3. Position multiple connector over amplifier terminals and secure connector with two screws.
4. Install plastic guard over edge of programmer housing as shown in Fig. 1-99 and secure with clip.
5. Connect transducer electrical leads as follows:

a. Yellow wire to inboard terminal.

b. Gray wire to outboard terminal.

6. Install transducer vacuum hoses as follows:

a. Black hose from programmer vacuum valve to top (small) port of transducer, Fig. 1-99.

b. White hose from checking relay to bottom (large) port of transducer, Fig. 1-99.

7. Position programmer vacuum valve in location on housing and secure with two screw/studs.
8. Install programmer cover.
9. Install programmer as described in Note 12b.

STANDARD SERVICE PROCEDURES

42. Differences in Air Conditioner Equipped Cars

Cadillac cars equipped with an air conditioner incorporate special engineering features to compensate for the extra weight, power requirements, and electrical loads demanded by the air conditioner system. The following features should be kept in mind when working on air conditioned cars.

a. Radiator Assembly

A special radiator is used with additional copper tubing for better cooling.

b. Power Steering Pump Pulley

A double sheave pulley is used on air conditioned cars.

c. Vapor Return Line

A vapor return line is connected from the fuel pump to the fuel tank to reduce the possibility of vapor lock.

d. Generator

A 63 ampere generator is used to accommodate the greater electrical load on all cars except the 697 which uses an 80 ampere model.

e. Suspension

Front coil springs have higher static load rate to compensate for additional weight of the system's components (except 693).

43. Handling Refrigerant and Refrigeration Components

a. Maintaining Chemical Stability

The efficient operation of the air conditioning system is dependent on the pressure-temperature relationship of pure refrigerant 12. As long as the system contains pure refrigerant 12 (plus a certain amount of refrigeration oil which mixes with the refrigerant), it is considered to be chemically stable.

When foreign materials, such as dirt, air or moisture are allowed to get into the system, they will change the pressure-temperature relationship of the refrigerant. The system will no longer operate at the proper pressures and temperatures, and the efficiency of the system will decrease.

The following general practices should be observed to insure chemical stability in the system:

1. Whenever it becomes necessary to disconnect a refrigerant connection, wipe away any dirt or oil at or near the connection to eliminate the possibility of dirt entering the system. Both sides of the connection should be immediately capped or plugged to prevent the entrance of dirt, moisture, or foreign material. All air contains moisture. Air that enters any part of the system will carry moisture with it and the exposed surfaces will collect the moisture quickly.

2. Tools should be kept clean and dry. This includes the Charging Station and the Gage Set.

3. When adding oil, the container and the transfer tube through which the oil will flow should be exceptionally clean and dry in order to keep the refrigeration oil as moisture-free as possible. For this reason, the oil container should not be opened until ready for use, and should be capped immediately after use.

4. When it is necessary to open a system, have everything needed ready and handy so that as little time as possible will be required to perform the operation. Do not leave the system open any longer than is necessary.

5. Any time the system has been opened and sealed again, it must be properly evacuated, as described in Note 46c.

CAUTION: Use only refrigerant from a reputable dealer, as contaminated refrigerant will not only lower the efficiency of the system, but will damage the unit. Use only refrigerant 12 as refrigerant for the Cadillac system, since any other refrigerant will damage the compressor or other parts by incorrect pressure-temperature relationship.

b. Precautions in Handling Refrigerant

Refrigerant 12 is stored and shipped as a liquid under pressure in heavy metal drums in 10, 25, and 145 pound sizes and in 1, 12, and 25 pound disposable containers. Correctly handled, it is as safe as compressed air. Incorrectly handled, it can explode and cause serious damage.

WARNING: IN HANDLING REFRIGERANT DRUMS, ALWAYS OBSERVE THE FOLLOWING SAFETY PRECAUTIONS:

1. DO NOT LEAVE DRUM UNCAPPED IF DRUM IS SO EQUIPPED. THE METAL CAP FURNISHED WITH THE DRUM WHEN IT IS SHIPPED IS TO PROTECT THE VALVE IN CASE THE DRUM IS ACCIDENTALLY KNOCKED OVER. THIS ELIMINATES THE POSSIBILITY OF THE DRUM FLYING THROUGH THE SHOP AND CAUSING SERIOUS DAMAGE TO PEOPLE AND PROPERTY. A SAFETY PLUG IS PROVIDED ON THE VALVE IN CASE THE TEMPERATURE EXCEEDS THE SAFE LIMITS OF THE DRUM. THE CAP IS DESIGNED SO THAT IF THE SAFETY PLUG AT THE VALVE SHOULD BLOW, THE REFRIGERANT WILL ESCAPE WITHOUT CAUSING THE DRUM TO MOVE.

2. DO NOT OVERFILL DRUM. A SAFETY PLUG IS PROVIDED IN CASE THE TEMPERATURE OF THE REFRIGERANT EXCEEDS THE SAFE LIMITS OF THE DRUM. HOWEVER, IF THE DRUM IS OVERFILLED, THE PRESSURE CREATED COULD CAUSE THE DRUM TO EXPLODE BEFORE THE TEMPERATURE RISES TO THE POINT WHERE THE SAFETY PLUG WOULD BURST AND ALLOW THE REFRIGERANT TO ESCAPE.

3. DO NOT CARRY THE DRUM IN THE PASSENGER COMPARTMENT OF A CAR. ALWAYS PLACE DRUM IN THE LUGGAGE COMPARTMENT OF CAR. IF A DRUM IS CARRIED IN AN OPEN TRUCK SHIELD IT FOR PROTECTION FROM THE SUN'S RAYS. THIS HEAT COULD INCREASE THE PRESSURE ENOUGH TO CAUSE SAFETY PLUG TO BURST.

4. DO NOT SUBJECT DRUM TO HIGH TEMPERATURE WHEN CHARGING SYSTEM – USE WATER NO WARMER THAN 125°F TO HEAT DRUM. NEVER PLACE DRUM ON STEAM RADIATOR OR STOVE, OR USE TORCHES FOR HEATING DURING CHARGING.

5. DO NOT DISCHARGE REFRIGERANT 12 INTO AREAS WHERE THERE IS AN EXPOSED FLAME OR WHERE IT COULD BE DRAWN INTO THE ENGINE AIR INTAKE WHEN THE ENGINE IS OPERATING. CON-

CENTRATIONS OF THIS GAS IN CONTACT WITH A FLAME MAY PRODUCE A POISONOUS GAS.

6. ALWAYS WEAR GOGGLES WHEN DOING WORK THAT INVOLVES OPENING THE REFRIGERANT LINES. AN ACCIDENT CAN EASILY CAUSE LIQUID REFRIGERANT TO STRIKE THE FACE. IF GOGGLES PROTECT THE EYES, THE LIKELIHOOD OF SERIOUS INJURY WILL BE REDUCED. A SKIN INJURY CAN BE BATHED WITH COLD WATER AND TREATED IN THE SAME MANNER AS FROSTBITE. IF REFRIGERANT LIQUID SHOULD STRIKE THE EYE, PROCEED AS FOLLOWS:

a. DO NOT RUB IT IN. SPLASH THE AFFECTED AREA WITH QUANTITIES OF COLD WATER TO BRING THE TEMPERATURE GRADUALLY ABOVE THE FREEZING POINT. APPLY A FEW DROPS OF ANTISEPTIC OIL TO PROVIDE A PROTECTIVE FILM.

b. IF IRRITATION CONTINUES, WASH THE EYES WITH A WEAK SOLUTION OF BORIC ACID.

c. CONSULT AN EYE SPECIALIST IMMEDIATELY FOR TREATMENT.

c. Welding

Excessive heat applied to any section of the refrigerant lines will create excessively high pressures. For this reason, welding should not be performed on any portion of the car adjacent to the refrigerant units or lines.

d. Undercoating

To simplify service operations, undercoating should not be applied to any connections or rubber lines of the refrigeration system. While it is permissible to undercoat the metal refrigerant lines, all flare joints and connections should first be masked.

e. Collision Service

It is very important that the air conditioning system be inspected as soon as possible whenever a car so equipped has been involved in a collision. If the system has been opened as the result of a collision, it will permit the entry of air, moisture, and dirt that will cause internal damage. As the length of time the system has been open and the extent of damage to the components will govern the replacement of parts and the service operations required, a definite procedure cannot be recommended to cover all cases. The following, however, may be used as a guide:

1. Make certain clutch is disengaged, if car is to be operated before repairs are made.
2. Inspect all units and lines, noting any damage.

a. If condenser is damaged, it should be replaced. No repairs such as soldering, brazing or welding should be attempted.

b. Replace dehydrator-receiver assembly if damaged, leaking, clogged or restricted, or if system was open for any period of time.

3. Check compressor and clutch pulley for cracks. If compressor does not show evidence of external damage, it may be used.

f. Handling Components

1. Store all lines to avoid crushing or kinking.
2. Lines should be kept sealed and dehydrated in stock. Do not remove shipping caps from lines until just before installation.
3. Always use two wrenches when tightening fittings to prevent twisting the hoses or soft aluminum tubing. Lubricate all fittings with refrigeration oil to allow the joint to be tightened without twisting the pipe.
4. Cap ends of lines that have been disconnected for any reason, to prevent entrance of moisture or dirt.
5. Gage set and lines should be kept clean and free from moisture.
6. Do not leave refrigeration oil container open any longer than necessary, as the special oil is moisture-free, but will rapidly absorb moisture from the air.
7. Use Vacuum Pump, J-5428, or Charging Station, J-23500,to remove any air or moisture that may have entered the system when it was opened to replace a part.

g. Replacing Components

When removing any components or lines from the system, they must be capped and plugged immediately to prevent exposing them to moisture.

All components of the air conditioning system are shipped dehydrated and sealed. They are to remain sealed until just prior to making connections and should be at room temperature before uncapping to prevent condensation of moisture from the air that enters the components. They should not be uncapped any longer than necessary to make a connection.

All precautions should be taken to prevent damage to the fitting and connections. Any fittings with grease or dirt on them should be cleaned prior to assembly, using a clean cloth dipped in alcohol. If dirt, grease or moisture gets inside lines and cannot be removed, lines may have to be replaced.

All blue O-rings for making closures for shipment should be discarded and new black O-rings used for making final refrigerant connections.

Use a small amount of refrigerant oil on all tubes and hose joints and lubricate the O-rings with this oil before assembly. Always slip the lubricated O-ring onto the flange tube to insure proper locating and sealing.

All O-ring connections should be tightened with torque wrenches and a crowfoot wrench (used at a 90° angle to the torque wrench for accurate reading,) in accordance with the table on page 1-105. Note that the torque specified for aluminum or copper tubing is less than that specified for steel tubing.

If a connection is made with steel to aluminum or copper, use torques for aluminum. In other words, use the lower torque specification. Use steel torques only when both ends of connection are steel.

Backing wrenches of the required size must be used during the final tightening of all O-ring and flare-type connections.

44. Maintenance and Inspection

The following items should be checked every spring and fall and whenever the car is brought in to check the air conditioning.

a. Functional Test of the Air Conditioner

See Note 49 to perform the test.

b. Sight Glass Check

Check sight glass through access hole in radiator cradle for full charge of refrigerant. If system is low, leak test and make necessary repairs. See Note 45.

(NOTE: It is normal for some foaming to occur in the sight glass with an outside air temperature of 70°F or below.)

c. Leaks

If there is evidence of oil leaks, leak test entire system and make necessary repairs. See Note 47.

d. Coolant Level

Check coolant for proper level. See Section 6, Note 4.

e. Belt Tension

Check tension of belts as described in Section 6, Note 10.

f. Compressor Clutch

Observe clutch to make certain it is engaging and disengaging while moving the selector lever between VENT and LO with the engine idling.

45. Checking Refrigerant Charge

Bubbles in the sight glass do not always indicate that the system is low on refrigerant. If the system is at a control point, bubbles may appear in the sight glass even though the system is fully charged.

A certain amount of foaming is also normal with an outside air temperature of 70°F or below.

Check refrigerant charge at the sight glass and proceed as described below to make certain that system is not at bubble producing control point.

1. Connect Charging Station low pressure line to gage fitting on suction throttling valve.
2. Move Automatic Climate Control lever to AUTOMATIC position and set temperature dial to 65°F.
3. Run engine at 1500 rpm for 5 to 7 minutes to stabilize system.
4. Observe low pressure reading. Low pressure gage should read approximately 29.5 ± .5 pounds.
5. Slow down engine.
6. Maintain engine speed at this level, wait several minutes and then observe sight glass.

a. If a solid column of refrigerant appears in sight glass, it is an indication that charge in system is adequate or overcharged.

b. If bubbles appear in sight glass, it is an indication that system is low on refrigerant. Add refrigerant to system as described in Note 46.

46. Purging, Evacuating and Charging the Refrigeration System

a. Purging Refrigerant From System

When replacing any air conditioner component, the system must be purged (drained) of refrigerant. The purpose is to lower pressure inside the system so that a component part can be safely removed. Following is a simplified procedure for purging refrigerant from system.

WARNING: ALWAYS WEAR GOGGLES WHEN DOING WORK THAT INVOLVES OPENING REFRIGERANT LINES.

1. Remove caps from pressure fittings on high pressure line and on suction throttling valve.
2. Install a length of 5/16" diameter clear plastic hose over the threaded end of adapter, J-5420. Secure with a clamp.
3. Install hose from J-5420 into a graduated container such as an empty refrigerant oil bottle.
4. Loosely install Gage Adapter, J-5420, on high side pressure fitting.
5. Tighten gage adapter and allow system to discharge at a rapid rate into the container.

(NOTE: Rapid discharge will cause oil loss; container is necessary to collect oil.)

6. Measure oil collected in container and discard old oil.
7. New refrigeration oil should be added to the system as described in Part F of this note. If this method is not practical, oil lost during rapid discharge must be replaced as follows.
8. Connect charging station low pressure line to fitting on STV.
9. Connect J-5420 to high pressure fitting.
10. Place hose from J-5420 into a container of fresh refrigeration oil.

(NOTE: Container should have more oil than was drained from system to prevent trying to draw all oil from bottle into system.)

CAUTION: Care should be exercised during this operation to ensure that no dirt is drawn into the system.

11. Start vacuum pump and draw into system, as much oil as was lost during rapid discharge. Remove hose from container when this point is reached.
12. Elevate hose to allow oil in hose to be drawn into system.
13. Remove J-5420 and proceed with normal evacuation and charging (Parts C and D of this note.)

b. Connection Charging Station, J-23500

1. Remove caps from high pressure fitting on high pressure line and the gage fitting on suction throttling

valve.

2. Make certain that all valves on charging station are closed.

3. Install Gage Adapters, J-5420, on Charging Station high and low pressure lines.

4. Connect charging station high pressure line to fitting on high pressure line and low pressure line to gage fitting on suction throttling valve, Fig. 1-100.

c. Evacuating System

Whenever the air conditioning system is opened for any reason, it should not be put into operation again until it has been evacuated several times. For this operation use Charging Station, J-23500, to remove air and moisture that may have entered the system.

Check Charging Station vacuum pump oil level at oil filler screw on front of pump. Oil should be level with bottom of filler tube, Fig. 1-101. Add 150 viscosity refrigeration oil to bring to proper level. Change the oil in pump every 250 hours of operation. A small amount of 150 viscosity oil may be drawn into the pump occasionally to insure protection of internal parts during periods of disuse. If the pump should fail to start, check capacitor or relay.

1. Purge system as described in part a of this note.
2. Connect Charging Station high and low pressure lines as described in part b of this note.
3. Plug in Charging Station to 110 volt outlet and turn on vacuum pump switch.
4. Open valve 1 (low pressure control), valve 2 (high pressure control), and valve 3 (vacuum control).
5. Operate to obtain 28 inches of vacuum, then continue to operate pump for ten minutes.

(NOTE: In all evacuating procedures specification of 28-29" of vacuum is used. This evacuation can only be attained at or near sea level. For each 1000 feet above sea level where this operation is being performed, specification should be lowered by one inch of mercury vacuum. At 5000 feet elevation only 23" to 25" of vacuum can normally be obtained.)

6. While evacuating the system, add refrigerant to cylinder on Charging Station by opening valves on refrigerant drum and at bottom of cylinder (valve 4 must be closed). Open valve on top of cylinder until proper liquid level is obtained in sight tube, and then close both top and bottom valves on cylinder.

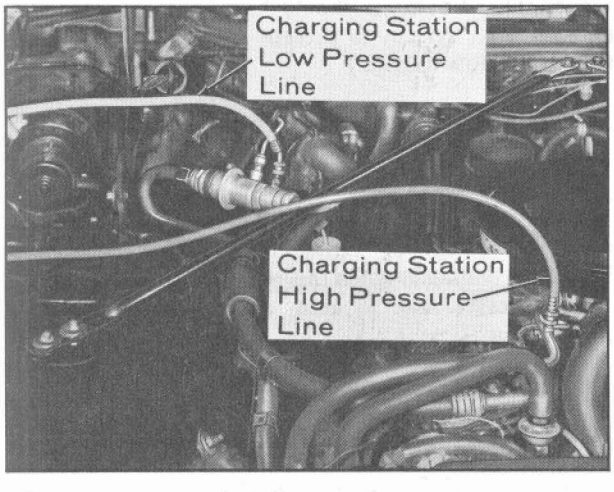


Fig. 1-100 Connecting Charging Station Lines

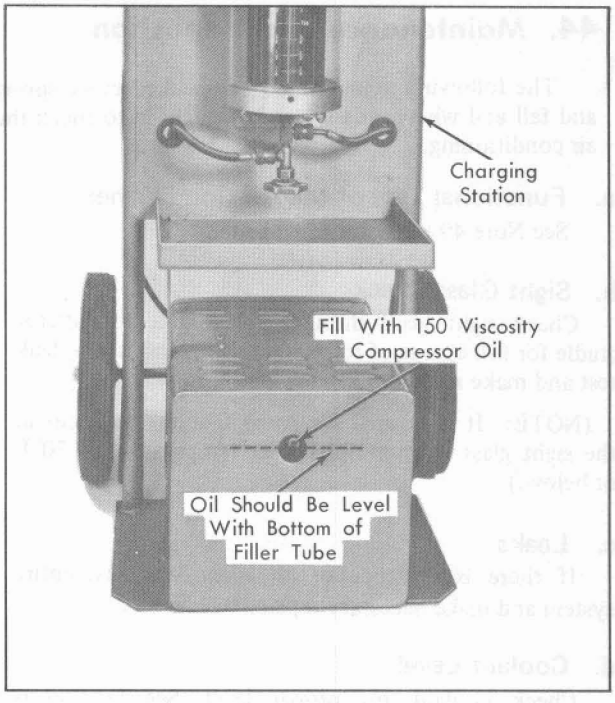


Fig. 1-101 Vacuum Pump Oil Level

7. Close valves 1, 2 and 3 and turn off vacuum pump switch. System should hold vacuum, unless there is a leak present.

8. Slowly open valves 2 and 4, allowing 1/2 to 1 lbs. of refrigerant to enter system, then close valves.

(NOTE: It is advisable at this time to leak test system for major leaks as described in Note 47.)

9. Purge system.
10. Repeat steps 4 and 5.
11. Repeat step 7.
12. System is now ready for complete charge of refrigerant as described in part d of this note.

d. Adding Refrigerant (Complete Charge)

1. Evacuate system as described in part c of this note. The system must be properly evacuated.

2. Fill cylinder on Charging Station with refrigerant as follows:

a. Open valves on refrigerant drum and bottom of cylinder (valve 4 must be closed).

b. Open valve on top of cylinder until proper liquid level is obtained in sight tube. (4 pounds on standard models, 5 1/4 pounds on Fleetwood Seventy-Five). Fleetwood Seventy-Five refrigerant will have to be added in two steps as required charge is greater than capacity of Charging Station cylinder.

3. Connect heating element plug to a 110 volt outlet.

4. Fully open valves 2 and 4 to allow refrigerant to flow into system.

(NOTE: If refrigerant does not flow freely into system, it is probably due to valve cores in high pressure line and STV fittings not being depressed far enough. If

this condition exists, try another Gage Adapter, J-5420, or build up an adapter depressor tongue with solder to depress valve core further.)

5. After liquid refrigerant has stopped flowing into high pressure side of system, close valve 2.
6. Start engine and run at approximately 1500 rpm with shift lever in PARK position.
7. Move Automatic Climate Control lever to AUTOMATIC position and set temperature dial to 65° F.
8. Open valve 1 (valve 4 must also be open). This will allow refrigerant remaining in cylinder to be pulled into system.
9. Shut off engine, close all valves, disconnect Charging Station high and low pressure lines and replace caps on fittings.
10. The system should not be overcharged due to excessive head pressures that result.

e. Adding Refrigerant (Partial Charge)

Refrigerant can be added to the air conditioning system using Charging Station, J-23500. The charging lines must be purged before any refrigerant is added.

1. Connect Charging Station as described in part b of this note.

(NOTE: Purge air from Charging Station high and low pressure lines before connecting. To purge lines, crack open valves 1, 2 and 4, making certain that there is some refrigerant in cylinder, then install lines and close valves.)

2. Operate engine at 600 rpm with shift lever in PARK position.
3. Move Automatic Climate Control lever to AUTOMATIC position and set temperature dial to 65°F.
4. Fill cylinder on Charging Station with 2 to 3 pounds of refrigerant, as follows:
   a. Open valves on refrigerant drum and bottom of cylinder (valve 4 must be closed).
   b. Open valve on top of cylinder until proper liquid level is obtained in sight tube.
   c. Close valve at bottom of cylinder.
5. Open valves 1 and 4. Watch sight glass until solid column of liquid appears, then close valves.

(NOTE: It is normal for some foaming to occur in sight glass with an outside air temperature at 70°F or below. (See note 45.)

6. After five minutes of operation, check sight glass again. If no bubbles appear, open valves 1 and 4 and add another 1/2 pound of refrigerant.
7. If bubbles appear, repeat steps 5 and 6.
8. Shut off engine, close all valves, disconnect Charging Station, and install gage fitting caps.
9. The system should not be overcharged due to excessive head pressures that result.

f. Adding Oil

The six-cylinder compressor uses 525 viscosity refrigeration oil. An oil charge of 10-1/2 fluid ounces is required, (13-1/2 fluid ounces on Fleetwood Seventy-Five models). It is important that only the specified type and quantity of oil be used in the compressor. If there is a surplus of oil in the system, too much oil will circulate with the refrigerant, causing the cooling capacity of the system to be reduced. Too little oil will result in poor lubrication of the compressor.

When it is necessary to replace a component of the refrigeration system or when the system is discharged at a rapid rate as described in part a of this note, certain procedures must be followed to assure that the total oil charge in the system is correct when the system is reactivated. When the compressor is operated, oil gradually leaves the compressor and is circulated through the system with the refrigerant. Eventually a balanced condition is reached in which a certain amount of oil is retained in the compressor and a certain amount is continually circulated. When the system is discharged at a rapid rate or a component of the system is removed after the system has been operated, some oil will go with it. To maintain the original total oil charge, it is necessary to compensate for this by adding oil to the new replacement part.

The procedures for adding oil are as follows:

1. Compressor Only

1. Idle engine for 10 minutes at 1000 - 1500 rpm at maximum cooling and high blower speed to allow oil to distribute itself in system in a normal manner.
2. Remove compressor from car and place it in a horizontal position with drain plug downward. Drain oil, measure, and discard it.
3. Drain oil from compressor that is to be installed in car.
4. If oil drained in step 2 is more than 4 fluid ounces, add to new compressor the same amount of oil as drained from replaced unit plus the amount lost during rapid discharge.
5. If the oil drained in step 2 is less than 4 fluid ounces, add 6 ounces of oil to new compressor, plus the amount lost during rapid discharge.

2. Replacing Components

Whenever replacing a component of the air conditioning system, measured quantities of 525 viscosity refrigeration oil should be added to the component to assure that total oil charge in system is correct before unit is operated.

Oil should be added to replacement components as indicated below.

Evaporator (front or rear)	Add 3 fluid ozs.*
Condenser	Add 1 fluid oz.*
Receiver	Add 1 fluid oz.*
Condenser and Receiver Assembly	Add 2 fluid ozs.*

*Plus the amount lost during rapid discharge.

Oil should be poured directly into the replacement component. If an evaporator is installed, pour oil into inlet pipe with pipe held vertically so oil will drain into core.

If any other components, such as valves or hoses are replaced, no additional oil is necessary.

3. Compressor and Components

CAUTION: If system has been operated and there is evidence of a major loss of oil, system has probably lost all or most of its refrigerant. If any refrigerant remains, discharge it from system. Do not operate compressor any more than is absolutely necessary to avoid damage from lack of oil.

1. Remove compressor and place in a horizontal position with drain plug downward. Drain oil from compressor, measure it and then discard it. To promote draining, have suction connector open and tilt compressor as required.

2. Replace damaged component from which the oil was lost.

3. If more than 4 fluid ounces of oil was drained from compressor in step 1, add same amount of new oil to compressor, plus an amount to compensate for that in damaged component, as shown in the table.

4. If less than 4 fluid ounces of oil was drained from compressor in step 1, add 6 fluid ounces of oil, plus amount shown in the table for component being replaced.

47. Leak Testing Refrigeration System

There are three methods that may be used for detecting leaks in the air conditioning system. The use of a leak detector fluid, a torch type leak detector or an electronic leak detector is recommended.

a. Leak Detector Fluid

Leak detector fluid (mixed with water per directions on bottle) may be used by daubing or squirting the liquid around joints to be tested. Ordinary leaks will form a cluster of bubbles almost immediately. Extremely small leaks will form a white foam which will materialize with a time limit from a few seconds to a minute, depending on size of leak.

In order to locate leaks with this fluid, it is essential that you see all of the surfaces you are checking with a good light; otherwise small leaks could easily be overlooked.

b. Torch Type Leak Detector

Detecting a leak with the torch type detector is accomplished by observing the color of the flame in the head of the detector, when the sampling tube is close to a refrigerant leak.

The flame can be described as three different colors: green, blue, and purple. Green indicates a small leak, blue indicates a medium leak and purple indicates a large leak.

WARNING: WHEN LEAK TESTING, AVOID INHALING FUMES OR GAS FROM DETECTOR TORCH. THEY MAY BE TOXIC AND CAUSE DAMAGE TO THE LUNGS IF INHALED. IT IS ALSO RECOMMENDED THAT A FIRE EXTINGUISHER BE CLOSE AT HAND WHEN USING THE LEAK DETECTOR TORCH.

To operate unit, open valve until a low hiss of gas is heard, then light the flame at opening in detector chimney. Adjust flame until blue flame is approximately 3/8 inches above reaction plate to make detector as sensitive as possible for small leaks.

When checking for leaks, always position sampling tube below fitting or area to be tested, as refrigerant 12 is a heavy vapor and will sink when exposed to air.

It is best to test low pressure side of system at drum pressure which is much higher than normal low side operating pressure.

In testing high pressure side for leaks, run system for a few minutes to build up pressure in high pressure side of system. Then stop engine and test high pressure side of system for leaks.

Do not attempt to leak test with the engine running in a drafty location as it will disperse the refrigerant 12 and be impossible to locate a leak.

c. Electronic Leak Detector

Two types of electronic leak detectors are recommended: the more recently available Refrigerant Gun, J-23400; and Electronic Leak Detector, J-22235. Instructions for their use are included with the equipment.

48. Cooling Capacity Performance Test

The following procedures pertain to all models except Fleetwood Seventy-Five. Performance Tests for the Fleetwood Seventy-Five Air Conditioning Systems are explained in Note 52.

a. Performing Test

1. Connect gage set high and low pressure lines, Fig. 1-100.

2. Hook up tachometer.

3. Disconnect vacuum hose to vacuum motor and plug hose or connect tester J-23678 and set for max. A/C.

4. Locate auxiliary fan 24" in front of condenser (12" in front of grille).

5. Place humidicator, J-6076, in auxiliary fan air stream in front of car.

6. Open both front doors.

7. Open all A/C outlets.

8. Insert a calibrated thermometer in righthand outlet, (J-22555).

(NOTE: Sensing bulb should not touch metal or plastic.)

9. Set A/C control lever to "Auto".

10. Place shift lever in "Park" and apply parking brake.

11. Start engine and set to run at 2,000 RPM.

12. Lower hood carefully to lowest position possible. Do not pinch or damage gage set hoses.

13. Allow engine to run for 10 minutes.

14. Record readings of:

a. Ambient dry bulb, which gives the temperature in front of the condenser.

b. Ambient wet bulb, which determines the humidity.

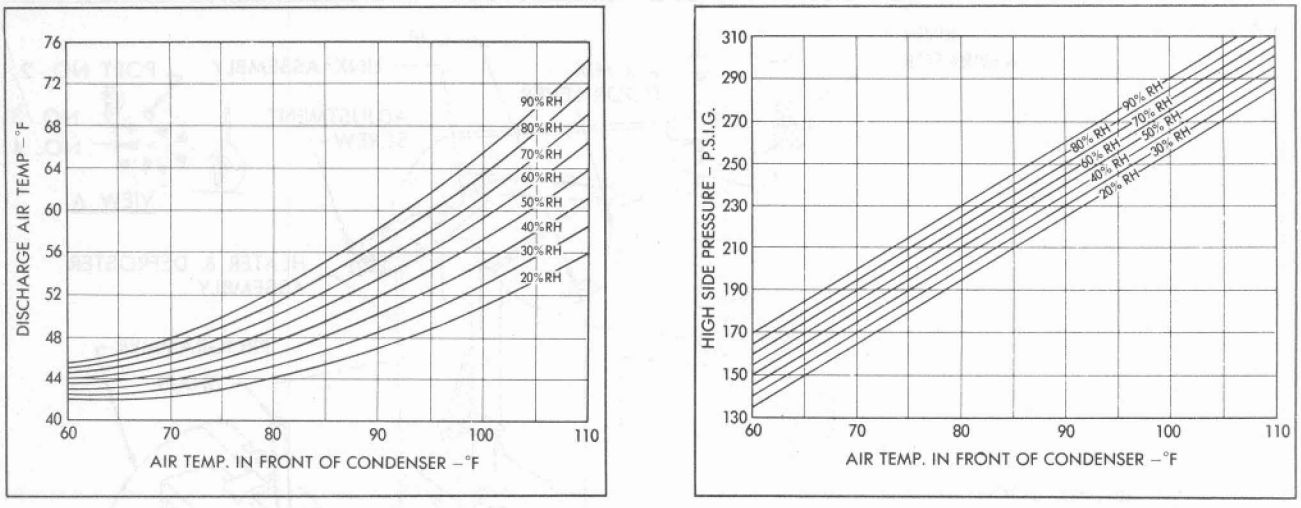


Fig. 1-102 A/C Performance Chart (Except 697)

c. High and low side pressures.
d. Air temperature at right hand outlet.

b. A/C Test Conclusions

The discharge temperature should agree with the value shown on the Discharge Air Temperature Chart, left side of Fig. 1-102 within ± 3°F.

The high pressure should agree with the value shown on the High Side Pressure Chart within 25 psi, right side of Fig. 1-102.

The low side pressure should be 29.5 ± .5 psig in all cases, except where ambient temperature and humidity are extremely high.

If these conditions are not met, refer to the diagnosis section.

49. Control System Functional Test

The following procedure is used to assure correct functional operation and requires approximately two minutes to perform. The system is to be tested at room temperature with the hood down, the doors and windows closed and the engine operating. Engine coolant must be warm. Proceed as follows:

1. Operate car at 1000 RPM or better.
2. Place A/C outlets in wide-open position.
3. Install thermometer in center A/C outlet.
4. Set control lever at "DEF" and temperature dial at 85°
   a. Air should be delivered out of the defroster outlets.
   b. Blower should operate at high speed.
   c. Some air should come out heater outlet.
5. Set lever at "BI-LEVEL" and temperature dial at 75°.
   a. Air should be delivered from both the A/C and heater outlets.
   b. Blower should operate at a lower speed.
   c. Small airflow should come from defroster outlets.
6. Set lever at "HI" and temperature dial at 65°.
   a. Cool to cold air should be delivered from A/C outlets.
   b. Blower should operate at high speed.
   c. Recirc air door should open (will be slightly noisy).
7. Set lever at "AUTO" and temperature dial at 65°.
   a. Recirc door should close (noise level will drop).
   b. After 45 seconds, discharge air temperature should be 50°F or lower (may be slightly higher in 90°F or above ambient).
8. Set lever at "AUTO" and temperature dial at 85°
   a. Blower speeds should drop (Hi - M_3 - M_2 - M_1 - etc.)
   b. Discharge air temperature should increase.
   c. Air delivery may change from A/C outlets to heater outlet - depending upon ambient temperature.
9. Set lever at "LO" and temperature dial at 85°. Air should be delivered at fixed low blower.
10. Set lever at "VENT" and temperature dial at 85°.
    a. Air discharge should be from A/C outlets.
    b. Blower should operate at fixed Lo speed.
    c. A/C compressor should not operate.
11. Set lever at "OFF" and temperature dial at 65°.
    a. Air discharge should be from heater outlet.
    b. Blower should operate at fixed Lo speed.
    c. A/C compressor should not operate.

50. Component Adjustments

Be sure to allow sufficient time for the car engine to "warm up" and for the system to "turn-on" before attempting calibration. Do not skip any steps in the Calibration Procedure.

a. Temperature Dial Calibration

1. Connect the ATC Tester J-23678 into the wiring harness and the programmer.

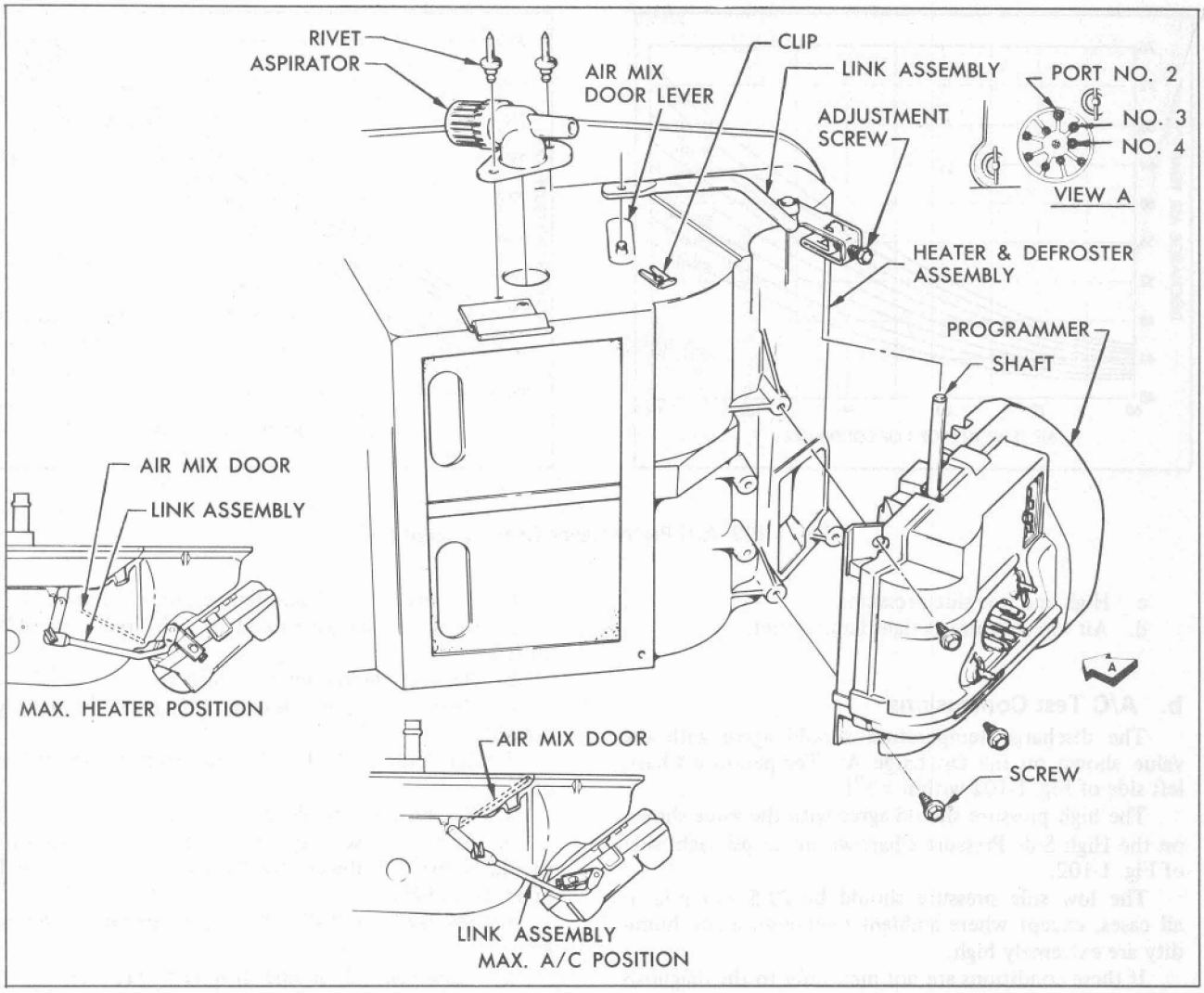


Fig. 1-103 Programmer Installation

2. Place the control head selector lever in the "VENT" position.

3. Place the "MANUAL-AUTOMATIC" switch on the tester in the "MANUAL" position.

4. Place the "TEMPERATURE DIAL CALIBRATOR" switch on the tester in the "CALIBRATE" position.

5. Note the voltmeter reading.

6. Press the "CALIBRATE" button and note the voltmeter reading.

7. With the "CALIBRATE" button pressed in, rotate the temperature dial on the control head until the voltmeter reading is the same as it was in Step 5 (when the button is not pressed in).

8. The temperature dial should be set at the temperature dial setting on the Tester panel. If it does not, use tool #J-21530 to hold the gear on the left side of the temperature dial and slip the temperature dial to the correct setting, Fig. 1-104. If the temperature dial cannot be calibrated using this procedure, it is defective.

b. Mix Door Link Adjustment

1. Loosen the hex screw of the door link at the output shaft of the programmer.

2. Place the control head selector lever in the "DEF" position.

3. Remove the electrical connector from the programmer. This results in the proper position of the output shaft of the programmer (full heat position).

4. Check to make sure that the air mix door is in the full heat position. The blower air flow will now hold the mix door in the proper position.

5. Without disturbing the door link or the output shaft position, tighten the hex screw on the door link.

6. Check the Mix Door Link Adjustment.

a. Connect Tester J-23678 into the wiring harness and the programmer. Place the control head in "AUTO". Place the "MANUAL-AUTOMATIC" switch in the "MANUAL" position. Using the "MANUAL CONTROL", swing the programmer to "Max. Heat" then to "Max. Cold". Hi blower should be obtained in both positions.

b. Check for recirculation operation. Operate the system with the "MANUAL CONTROL" on "150" for 5 minutes so the restricted vacuum line can move the outside air door to the outside air position. With the control head in "HI", move the "MANUAL CONTROL" to "Max. Cold". With all the car doors and windows

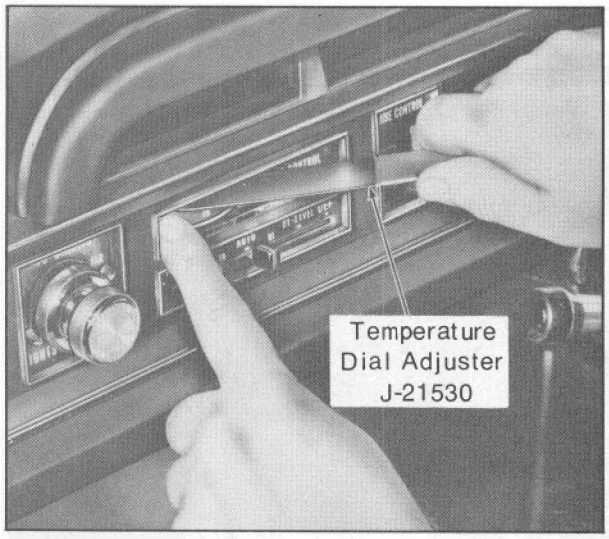


Fig. 1-104 Adjusting Temperature Dial

closed, the blower noise level should increase when recirculation occurs (approximately 3 minute delay due to the restrictor).

c. Programmer Amplifier Calibration (Feedback "Pot" Adjustment)

1. Remove the plastic cover from the programmer while it is still mounted in the car.
2. Connect the Tester J-23678 into the wiring harness and the programmer.
3. Place the control head selector lever in the "AUTO" position.
4. Place the "MANUAL-AUTOMATIC" switch on the tester in the "MANUAL" position.
5. Place the "TEMPERATURE DIAL CALIBRATOR" switch of the tester in the "OFF" position.
6. Rotate the "MANUAL CONTROL" knob on the tester to the "Max. Heat" position. The programmer should move to the full heat position.
7. Rotate the "MANUAL CONTROL" knob to 180 and STOP. DO NOT OVER-TRAVEL!
8. Using a blade type screwdriver, slip the shaft of the feedback potentiometer fully counterclockwise to its stop (see figure 1-99 for location of the feedback potentiometer in the programmer). The vacuum motor mechanism will be "in" the vacuum motor indicating full heat operation.
9. Using the screwdriver, very slowly slip the feedback potentiometer clockwise until the first movement of the vacuum motor mechanism can be seen. Stop the adjustment when the movement first occurs. (Do not watch the programmer output shaft.)
10. To check the adjustment, rotate the "MANUAL CONTROL" knob to the "Max. Heat" position. Then slowly rotate the "MANUAL CONTROL" knob counterclockwise and the vacuum motor mechanism should first start to move when the "MANUAL CONTROL" knob is exactly at 180 ± 1. Touch up the feedback potentiometer adjustment in the programmer so that the mechanism movement occurs exactly 180. If this adjustment cannot be made, the programmer is defective.

d. Compressor Drive Belts

The compressor drive belts are adjusted at the power steering pump. Follow procedure described in Section 6, Note 10.

THEORY OF OPERATION
FLEETWOOD SEVENTY-FIVE AIR CONDITIONER

Two separate air conditioning systems are used in the Fleetwood Seventy-Five Cadillac. In each system automatic temperature control is provided. The front compartment system utilizes the same components and operates in the same manner as the air conditioner on all other 1972 model cars, with the following exceptions:

The front system refrigerant and heater water hoses have "tee" connections incorporated to provide feed to the rear system.

The rear compartment system utilizes a series-flow, reheat-type evaporator, heater and blower assembly, located on the axle kickup shelf in the trunk compartment. This assembly draws car interior air from the rear compartment through the package shelf, cools and reheats it as required, and discharges it into the passenger compartment through overhead roof ducts or through duct-work and grilles in the rear doors. When the system operates in heater mode, a portion of the heated air is directed at the rear window through grilles in the package shelf for defrosting purposes.

A complete string of sensors, an amplifier, a transducer, a power servo and other temperature control components are utilized in the rear system. A description of these follows.

Automatic Climate Control Components (697 Rear) (Fig. 1-105 and Fig. 1-106)

a. Sensors

The in-car sensor, mounted in a grille located on the rear package shelf, senses the temperature of the passenger compartment as well as the sun load on the rear of car.

The duct sensor senses the discharge air temperature. It is located in the mode door assembly on the right side of the car where it is exposed to all discharge air entering this area.

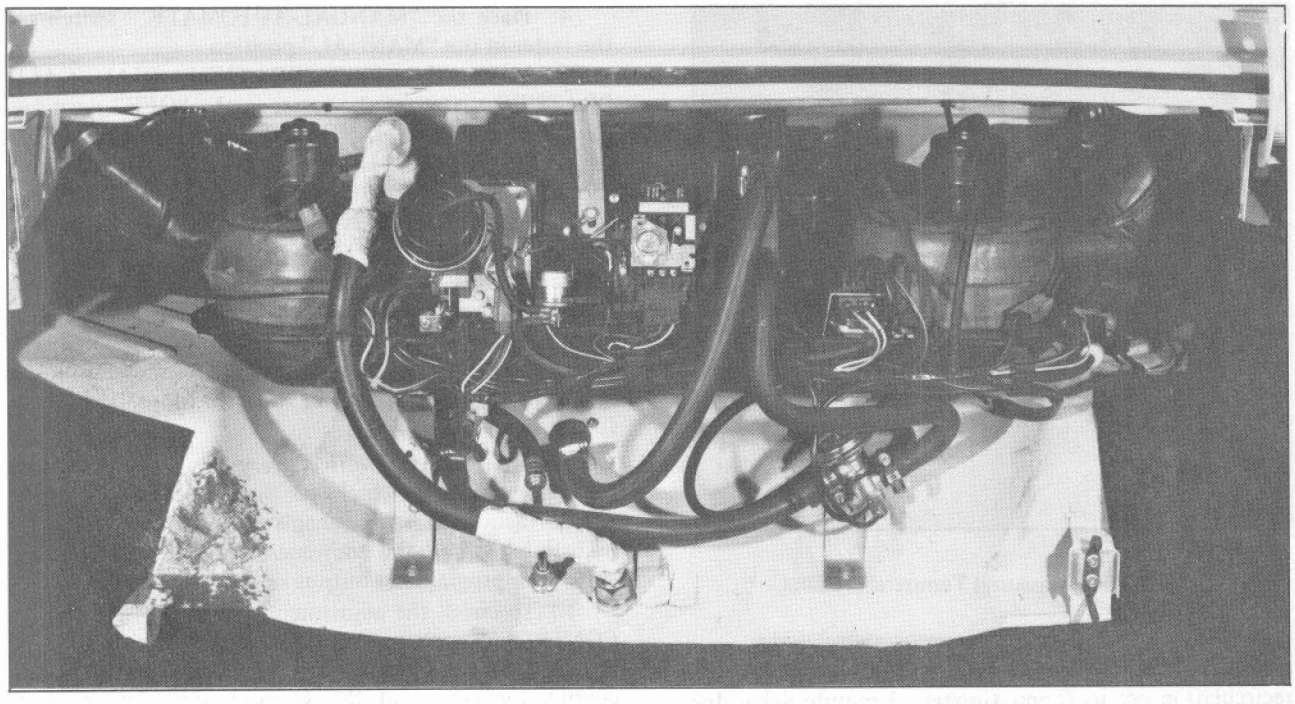


Fig. 1-105 697 Rear Unit on Car

The ambient sensor is located with the ambient sensor for the front system on the top of the evaporator case. It senses the temperature of the ambient air entering the system.

b. Temperature Dial

The temperature dial is located in the right rear quarter panel trim. The dial is graduated in 5°F divisions to allow the passenger to select any temperature in the 65°F to 85°F range.

c. Vacuum On-Off Switch

The Vacuum On-Off switch is located with the temperature dial in the right rear quarter panel trim. This switch allows the passenger to turn the rear system off.

d. Amplifier

The amplifier is mounted on the rear face of the rear unit case assembly in the trunk.

e. Transducer

The transducer for the rear assembly is mounted on the rear face of the case assembly just to the left of the amplifier.

f. Power Servo

The power servo is mounted on the left vertical surface of the case assembly.

Suction Throttling Valve (697 Rear) (Fig. 1-10)

The pilot operated absolute suction throttling valve is located on the left front side of the evaporator assembly, in the low pressure line to the compressor. The valve body contains two ports; the evaporator gage port on the inlet side of the valve, and a port on the outlet side for the external equalizer line.

This valve works in the same manner as that used on front systems, but is calibrated to control the rear evaporator pressure to 27 psi.

Expansion Valve (697 Rear)

An expansion valve is used in the rear system to perform the same function as the valve used in the front system. The rear expansion valve is contained within the evaporator case on the lower left front side.

Evaporator (697 Rear)

The evaporator used on the rear system is smaller and of different construction than that used in front systems. The rear evaporator is located in the case assembly in the luggage compartment under the package shelf.

Blower Assemblies (697 Rear)

Two blower assemblies are used on the rear system. Air from the heater air conditioner assembly is drawn into blower assemblies on either side of the case and then expelled into the car.

Control Panel (697 Rear)

The control panel, (Fig. 1-107), located in the right rear quarter panel trim, consists of a temperature dial and an ON-OFF switch. The temperature dial is graduated in 5 degree divisions from 65°F to 85°F. This dial is used to select the desired temperature. The ON-OFF switch controls vacuum feed to the rear system and is used to turn the system On or Off.

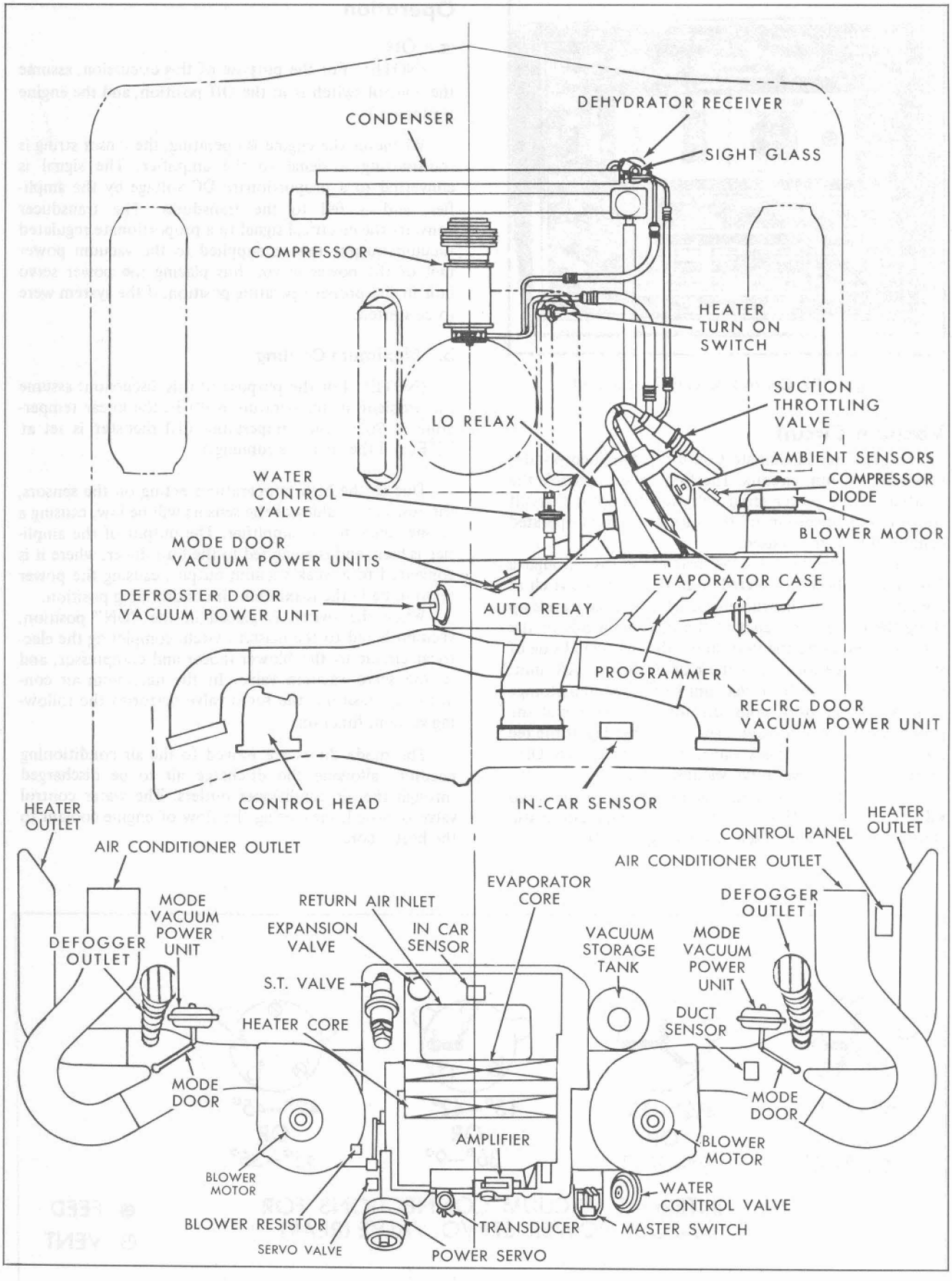


Fig. 1-106 Location of 697 A/C Units

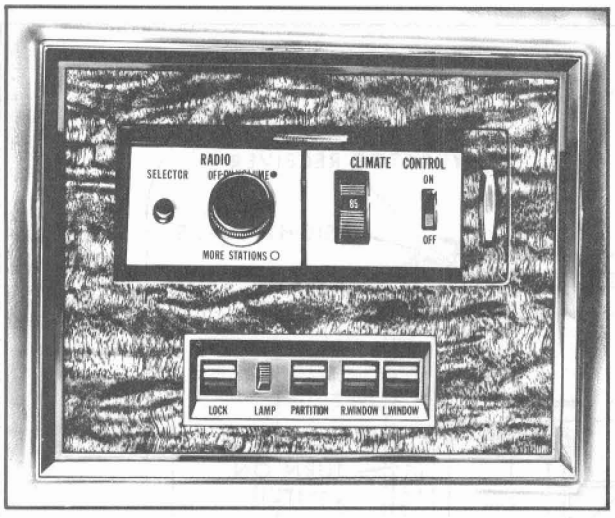


Fig. 1-107 Control Panel-697 Rear Unit

Vacuum Circuit

The Automatic Climate Control system incorporates two basic vacuum circuits. The first circuit controls the position of the power servo unit, and the second circuit controls the operation of the various vacuum operated components of the system.

The vacuum feed to the rear system is through a 1/4" rubber hose connected near the neutral switch at the left side of the instrument panel. The hose travels up along the center vent duct to the right-hand side of the car and then along the floor down the right-hand side of the car to a tee located at the rear of the rear A/C unit. One leg of the tee feeds vacuum to the vacuum storage tank which, in turn, connects the transducer and the power servo vacuum diaphragm. The other leg of the tee feeds vacuum to a check valve, the customer "On-Off" switch, and the power servo vacuum valve.

To trace the path of the vacuum, refer to the servo valve connections (Fig. 1-108) and to rear automatic climate control vacuum schematic (Fig. 1-109).

Operation

a. Off

(NOTE: For the purpose of this discussion, assume the control switch is in the Off position, and the engine is running.)

Whenever the engine is operating, the sensor string is transmitting a signal to the amplifier. The signal is converted to a proportionate DC voltage by the amplifier, and is fed to the transducer. The transducer converts the electrical signal to a proportionate regulated vacuum output that is supplied to the vacuum power unit of the power servo, thus placing the power servo unit in the proper operating position, if the system were to be started.

b. Maximum Cooling

(NOTE: For the purpose of this discussion: assume the ambient air temperature is 90°F, the in-car temperature is 90°F, the temperature dial rheostat is set at 75°F, and the engine is running.)

Due to the high temperatures acting on the sensors, the resistance values of the sensors will be low, causing a strong signal to the amplifier. The output of the amplifier is high, and is being fed to the transducer, where it is converted to a weak vacuum output, causing the power servo to be in the maximum air conditioning position.

When the switch is placed in the "ON" position, vacuum is fed to the master switch, completing the electrical circuit to the blower motor and compressor, and to the servo vacuum valve. In the maximum air conditioning position, the servo valve performs the following vacuum functions:

The mode doors are moved to the air conditioning position, allowing the discharge air to be discharged through the air conditioner outlets. The water control valve is closed, preventing the flow of engine coolant to the heater core.

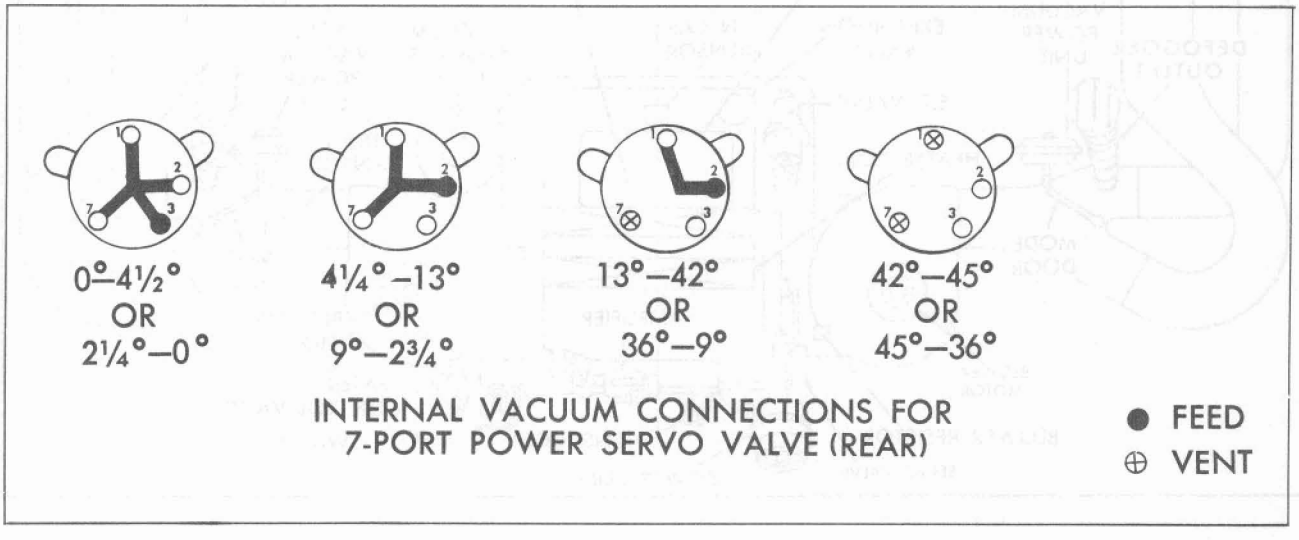


Fig. 1-108 Rotary Valve Internal Connections–697 Series

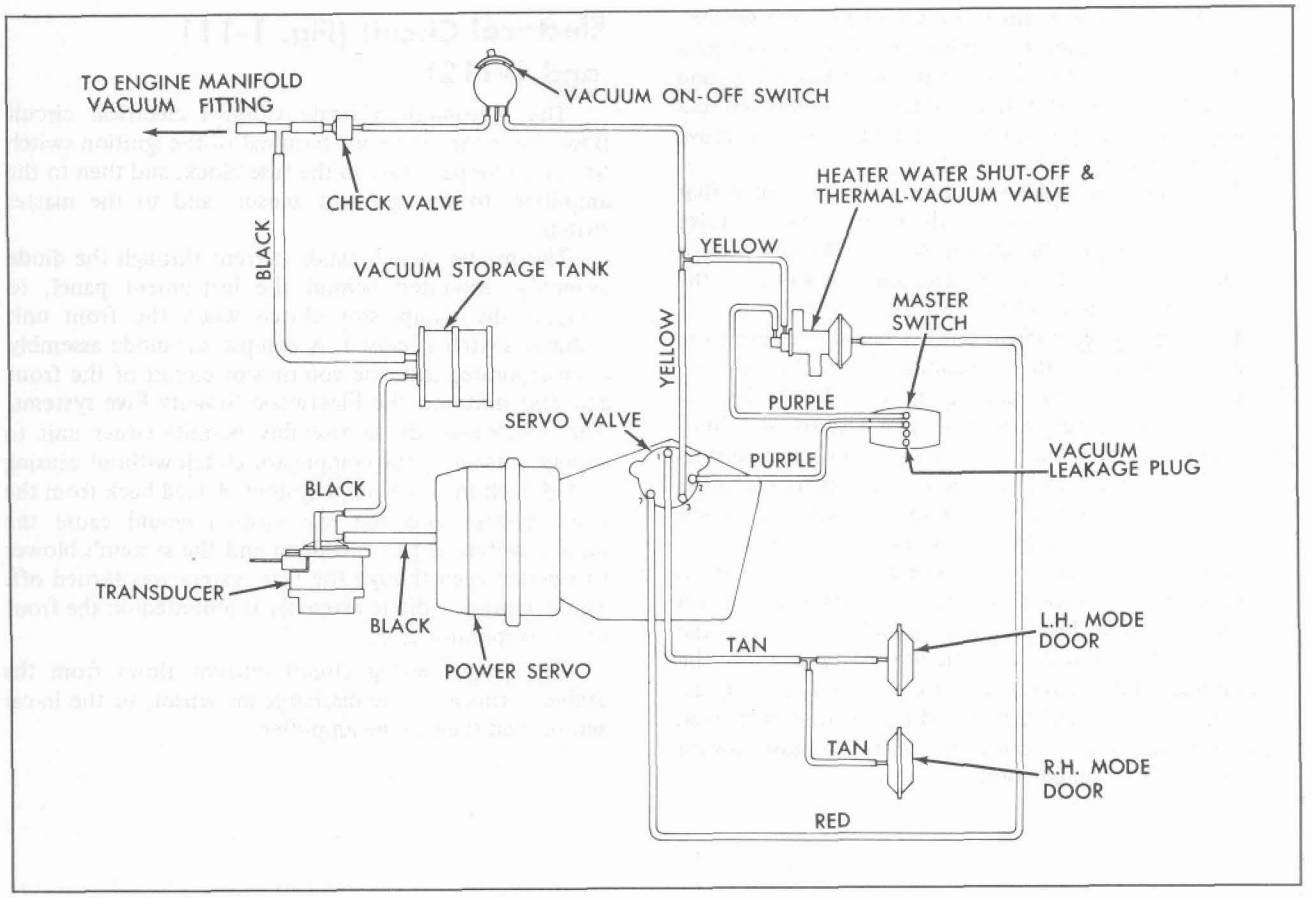


Fig. 1-109 Rear A/C Vacuum Schematic—697 Series

In addition, the power servo has placed the temperature door in the maximum cooling position, preventing any air flow through the heater core. The blower is operating at HIGH speed.

As the system operates the in-car and duct sensors, sensing the lowering temperatures, increase in resistance, causing more vacuum to be fed to the power servo unit. The power servo then performs the necessary events, in the proper sequence, Fig. 1-110, until such time as the system reaches a balanced position to hold the interior temperature to the dial setting.

As the vacuum supplied to the power servo vacuum power unit increases, the position of the operating arm and the servo vacuum valve changes. The blower decreases to M2 speed. Vacuum to the hot water valve is cut off, causing the hot water valve to pass engine coolant.

Power Servo Arm Angle		Event
Increasing Vacuum	Decreasing Vacuum	
4-1/4°	2-3/4°	A/C Over Ride Begin - End
13°	9°	Water Control Valve Close - Open
42°	36°	Change Mode A/C - Heat

Fig. 1-110 Sequence of Events—697 Series

As the system continues to modulate, the blower will decrease to M1 speed and then the position of the temperature door will change to allow the entry of heated air that will mix with the cooled air. Continued modulation by the system can decrease the blower to LOW speed. The system will modulate itself to maintain the interior temperature, regardless of any change in the ambient air temperature.

If the ambient air temperature were to fall quite rapidly, the ambient sensor resistance value would increase, causing a weaker voltage signal to be sent to the transducer. The power servo unit would move towards the heater position as the vacuum output from the transducer was increased. The system would switch into the heater mode and the blower speed would increase to M1, then M2, and HIGH. During the increase of blower speeds, the temperature door would be traveling toward the maximum heat position and eventually would prevent all cold air from entering the system.

c. Maximum Heat

(NOTE: For the purpose of this discussion, assume the ambient air temperature is 0°F, the in-car temperature is 0°F, the temperature dial is set at 75°F, and the engine is running.)

Due to the low temperatures acting on the sensors, their resistance values will be high, causing a weak signal to the amplifier. The output of the amplifier is low, and is being fed to the transducer, where it is converted to a strong vacuum output causing the power servo to move toward the maximum heat position.

In the heat mode, the vacuum circuitry is such that the vacuum must pass through the thermal vacuum valve in order to actuate the master switch. The compressor clutch circuit is held open by the ambient switch in the front unit any time it is below 32°F.

Once the engine coolant has reached the temperature of approximately 140°F, vacuum flows through the thermal vacuum valve, causing the outside air door to open and the blower to operate at HIGH speed, admitting heated air into the car. The in-car and duct sensors sense the temperature rise and, as their resistance values lower, the system begins to modulate and the blower speeds will diminish to M2, M1 and then to LOW.

During the decrease in blower speeds, the temperature door would travel from the maximum heat position to a mid-position, blending heated and cooled air. If the outside air temperature were to rise to about 35°F, the compressor clutch circuit would close, causing compressor operation to begin. Continued temperature increases, sensed by the sensors, cause the system to move toward the air conditioning position.

Electrical Circuit (Fig. 1-111 and 1-112)

The Automatic Climate Control electrical circuit flows from the accessory terminal of the ignition switch to the 15 ampere fuse in the fuse block, and then to the amplifier, to the ambient sensor, and to the master switch.

The master switch sends current through the diode assembly, mounted behind the instrument panel, to energize the compressor clutch when the front unit ambient switch is closed. A compressor diode assembly is incorporated into the compressor circuit of the front and rear units on the Fleetwood Seventy-Five systems. The compressor diode assembly permits either unit to supply current to the compressor clutch without causing a feed back into the other system. A feed back from the front system into the rear system would cause the master switch to be overridden and the system's blower to operate even though the rear system was turned off. The compressor diode assembly is mounted on the front of the evaporator case.

The sensor string circuit current flows from the ambient sensor to the discharge air sensor, to the in-car sensor, and then to the amplifier.

SERVICE INFORMATION
FLEETWOOD SEVENTY-FIVE AIR CONDITIONER

51. Adjustments (697 Rear)

a. Temperature Door Link

1. Loosen temperature door adjusting link screw.
2. Apply vacuum to power servo vacuum power unit.
3. Tighten temperature door adjusting link until head of screw contacts link then continue to tighten just enough to take play out of link.

b. Temperature Dial

(NOTE: If system is working properly, perform temperature dial test as described in Notes 54a, step 6, 54b, step 7, or 54c.)

Although the temperature dial may be operating correctly, it may be necessary to change the temperature dial setting for customer satisfaction. If an owner indicates a particular temperature dial setting where he is most comfortable, set temperature dial to that setting and proceed as follows:

1. Insert Temperature Dial Adjuster, J-21530, between temperature dial and casting. (Refer to Fig. 1-104.)
2. Turn dial to proper setting as determined by test procedure used.

52. Performance Test (697 Only)

To determine the efficiency of the Fleetwood Seventy-Five Air Conditioning system, run a performance test as outlined below:

1. Place transmission in PARK and start engine.
2. Check operation of controls by rotating temperature dials from stop to stop.
3. Turn off engine.
4. Purge high and low pressure lines on Charging Station J-8393.
5. Connect Charging Station high pressure line to fitting on high pressure vapor line, and low pressure line to evaporator gage fitting on suction throttling valve.
6. Disconnect vacuum hoses from both power servo vacuum power units and plug hoses.
7. Close hood as far as possible without pinching lines.
8. Place auxiliary fan (approximately 24 inch dia. blades) 24 inches from front bumper and direct air stream to center of radiator grille.
9. Place thermometer in air stream between auxiliary fan and radiator grille. Thermometer bulb must not contact any metal.
10. Place another thermometer in right front air conditioning outlet grille. Thermometer bulb must not contact any metal.

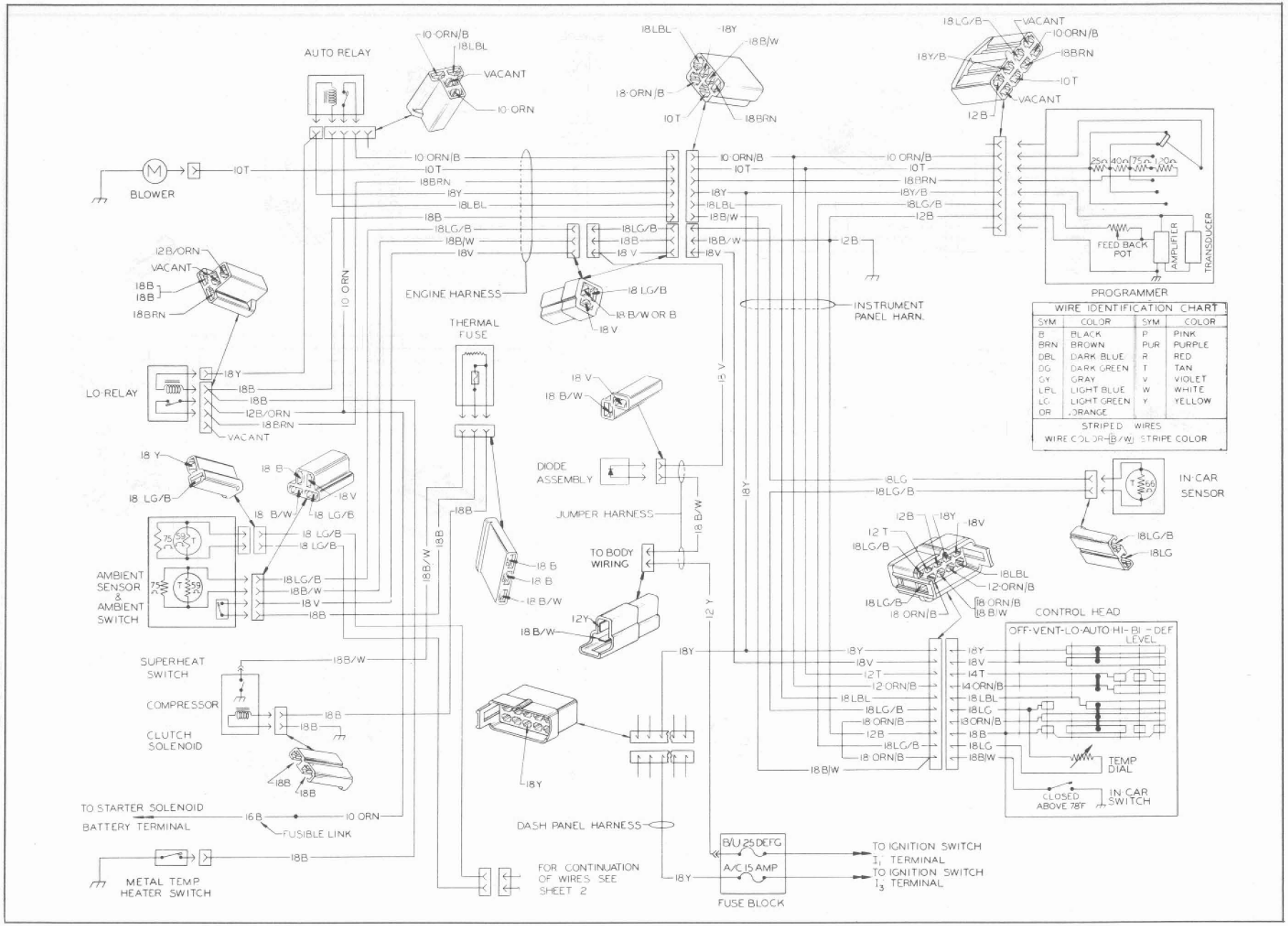


Fig. 1-111 Front A/C Circuit Diagram—697 Series

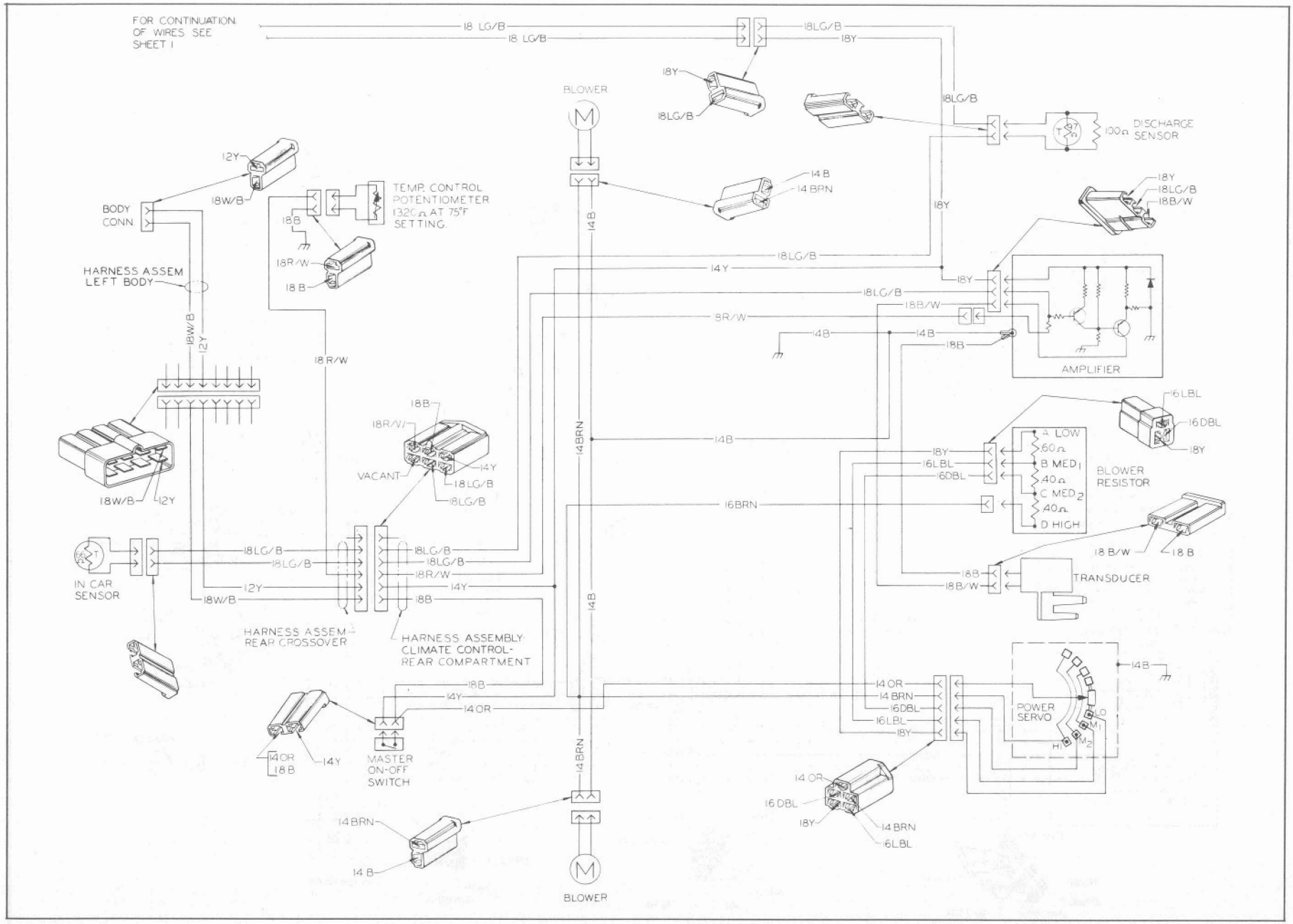


Fig. 1-112 Rear A/C Circuit Diagram—697 Series

11. Open all doors and windows.

12. Use Humidicator, J-6076, to obtain simultaneous temperature and relative humidity readings of air entering air intake grille as follows:

a. Shake thermometer down to settle red and blue columns in bottom of tubes.

b. Throughly moisten wick on blue thermometer with water.

c. Place humidicator on right hand side of cowl air intake grille so that entering air passes over bulbs of thermometer.

13. Place thermometer in right rear roof outlet and open deflector doors.

14. Place another thermometer on center of package shelf over return air intake.

15. Turn on auxiliary fan.

16. With transmission in PARK, start engine and operate at 2,000 rpm.

17. After five minutes, record:

a. Humidicator red and blue bulb readings. (Red bulb reading is temperature of air entering air intake, grille.)

b. Temperature of air being discharged through right front air conditioning outlet.

c. Temperature of air entering grille.

d. Head pressure.

e. Front evaporator pressure.

f. Temperature of air being discharged from right rear outlet.

g. Temperature of air returning to rear evaporator assembly.

18. Turn off engine and auxiliary fan.

19. To determine relative humidity of air entering air intake grille, position inner scale of humidicator so that blue (wet bulb) temperature is opposite red (dry bulb) temperature. Relative humidity is indicated by humidity arrow. Record relative humidity.

20. Refer to Chart C, Fig. 1-113 to determine if outlet air temperatures are normal. If outlet temperatures are the same or below reading on chart, operation is normal.

21. Refer to Chart D, Fig. 1-113 to determine if head pressure is normal. If head pressure is within 30 pounds below reading on chart, operation is normal.

22. Disconnect Charging Station.

23. Install vacuum hose on power servo vacuum power units after unplugging.

53. Connecting Automatic Climate Control Tester

The Automatic Climate Control Tester, J-21512, and the Automatic Temperature Control Tester, J-22368-01, are used to isolate an electrical malfunction in the Automatic Climate Control system by serving as a substitute for components of the system. To use:

1. Remove trim panel inside luggage compartment.

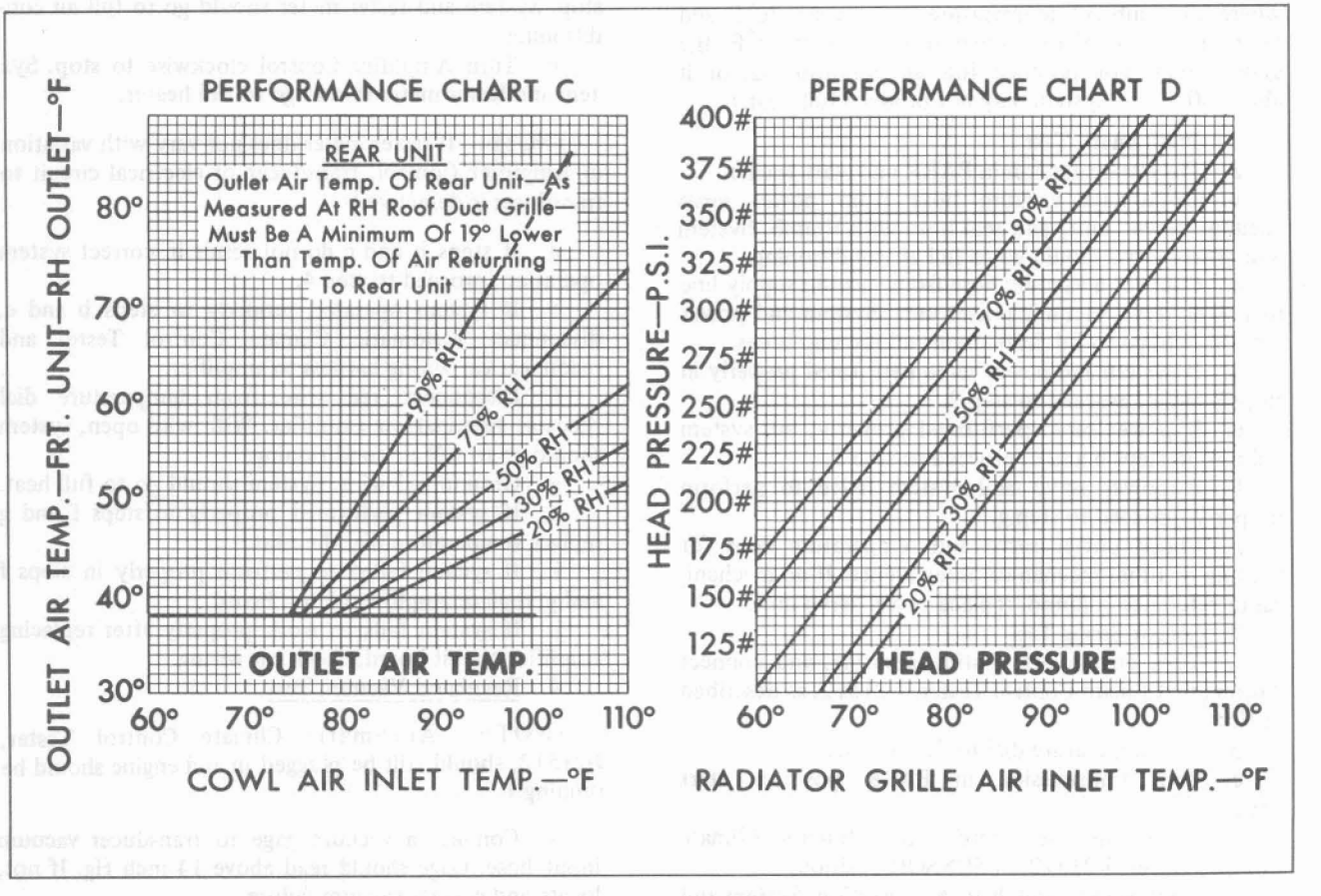


Fig. 1-113 A/C Performance Chart—697 Series

2. Disconnect three-way connector from amplifier.
3. Connect three-way electrical connector of tester -- the one with three female terminals -- to amplifier terminal.
4. Connect second multiple connector of tester to car wiring harness.
5. Connect ground lead to car body.
6. When using J-22368-01, disconnect large vacuum hose at transducer and insert tester tee in vacuum line.

54. Testing Automatic Climate Control System

Two testers are available to perform these tests. Due to differences between the testers, two procedures are given in this note. Follow the test procedure that applies to the tester to be used.

a. Automatic Climate Control Tester, J-21412

This procedure is designed to assist servicemen in locating a malfunction in the Automatic Climate Control system, when the system turns ON, but operates only in maximum heat or maximum air conditioner at high blower speed. If the system is operating incorrectly, but does have some degree of self-modulation, first check adjustment of temperature dial as described in step 6. If system still performs incorrectly, proceed as follows:

(NOTE: For positive results, the Automatic Climate Control system should be tested in an area where the ambient temperature is between 70°F and 80°F. If the ambient temperature is below 70°F, the system may not produce full air conditioning, or if above 80°F, the system may not produce full heat.)

1. Preliminary Test

a. Place transmission in PARK and start engine.

b. Disconnect vacuum hose from power servo vacuum power unit, and seal hose with thumb. System and power servo should go to full air conditioning.

c. Connect a vacuum hose from vacuum supply line to power servo vacuum power unit. System and power servo should go to full heat. Reinstall vacuum hoses.

d. If system and power servo performed properly in stops b and c, proceed to step 2.

e. If power servo performed properly, but system did not, in steps b and c, proceed to step 5.

f. If power servo and system failed to perform properly, proceed to step g.

g. Check power servo and temperature door for binding or other mechanical interference. If no mechanical interference is found, replace power servo unit.

2. Sensor String Test

a. Turn engine off if still operating, and connect Automatic Climate Control Tester, J-21512, as described in Note 51.

b. Set temperature dial to 71° setting.

c. With transmission in PARK position, start engine.

d. Place Amplifier switch on Automatic Climate Control Tester, J-21512, in SENSOR position.

e. Place Sensor switch to A/C position, System and tester meter should go to full air conditioning.

f. Place Sensor switch in HTR position. System and tester meter should go to full heater.

g. If system did not perform correctly in steps e and f, proceed to step 3.

h. If system performed correctly, disconnect Automatic Climate Control Tester and reconnect car wiring harness. Visually inspect in-car sensor, replace if apparently defective, and check operation of system.

i. Check for loose connector at duct sensor and then at ambient sensor. If loose connector is found, repair and check operation of system.

j. If an ohmmeter is available, measure resistance value of ambient sensor, duct sensor and then in-car sensor. Sensor resistance value should approximate resistance value given in Fig. 1-53. Replace any defective sensor located. If no defective sensor is found, check car wiring.

k. If an ohmmeter is not available, substitute a known good ambient sensor, duct sensor, and then in-car sensor; check operation of system after each substitution. If system still fails to perform satisfactorily, check car wiring.

3. Amplifier Test

CAUTION: Sensor string must be tested before testing amplifier.

a. Place Amplifier switch on Automatic Climate Tester, J-21212, in AMPLIFIER position.

b. Turn Amplifier Control counterclockwise to stop. System and tester meter should go to full air conditioning.

c. Turn Amplifier Control clockwise to stop. System and tester meter should go to full heater.

(NOTE: If tester meter does not vary with variation in Amplifier Control, transducer or electrical circuit to transducer is defective.)

d. If steps b and c do not result in correct system operation, proceed to step 4.

e. If system operated properly in steps b and c, disconnect Automatic Climate Control Tester and reconnect car wiring harness to amplifier.

f. Disconnect red wire from temperature dial rheostat terminal on amplifier. With wire open, system should go to full air conditioning.

g. Ground red wire. System should go to full heat.

h. If system performed properly in steps f and g replace temperature dial rheostat.

i. If system failed to perform properly in steps f and g, replace amplifier circuit board.

j. If system fails to work properly after replacing amplifier circuit board, check car wiring.

4. Regulated Vacuum Test

(NOTE: Automatic Climate Control Tester, J-21512, should still be plugged in and engine should be running.)

a. Connect a vacuum gage to transducer vacuum input hose. Gage should read above 14 inch Hg. If not, locate and correct vacuum failure.

b. Reconnect vacuum input hose and connect

vacuum gage to transducer output fitting, using a length of vacuum hose.

c. Make certain that temperature dial is at 71° setting.

d. Place Amplifier switch on Automatic Climate Control Tester, J-21512, in SENSOR position. Turn sensor switch to MID position and rotate temperature dial until tester meter needle reads on set line. Vacuum gage should read between 3.5 inch Hg. and 7.2 inch Hg. If not, replace transducer.

e. Rotate temperature dial to 65° setting. Vacuum gage should read 1.5 inch Hg. or less. If vacuum reading is lower, turn Sensor switch to A/C position, gage should now read 1.5 inch Hg. or less. If not, replace transducer.

f. Repeat step d.

g. Rotate temperature dial to 85° setting, vacuum gage should read 10 inch Hg. or more. If vacuum reading is lower, turn Sensor switch to HTR position, gage should now read 10 inch Hg. or more. If not, replace transducer. Check car wiring.

h. Rotate temperature dial to 71° setting and place Amplifier switch in AMPLIFIER position. Rotate tester Amplifier control from stop to stop. Output of transducer should vary between 1.5 inch Hg. or less, to 10 inch Hg. or more within 10 seconds. If not, replace transducer.

5. System Vacuum Test

a. Tee in a vacuum gage to any nipple of the master switch, and position vacuum gage so that it can be read from the seat.

b. Set the temperature dial to 71° and start engine. Vacuum gage should read above 14 inch Hg. at idle and stay at this setting throughout the check.

c. Slowly rotate temperature dial to 85°, and then back to 65°. If the temperature dial is rotated too rapidly, the vacuum may drop to 9 inch Hg. or so, but it should return to the original setting. This is a normal condition. However, if a vacuum leak is present, the vacuum reading will drop to 6 inch Hg. or less and remain there.

(NOTE: It is possible that a vacuum leak may show up only at a particular setting of the temperature dial. Therefore, whenever the vacuum drops, immediately stop rotating the dial until you are certain whether a leak is present or whether you were turning the dial too fast.)

d. Rotate temperature dial back to 71° except in OFF position, where there should be no vacuum reading.

e. If a vacuum leak is present, determine when it is present. Then, referring to Figs. 1-85 and 1-86 determine what valves, hoses and vacuum power units are involved to locate leak.

6. Temperature Dial Test with Automatic Climate Control Tester, J-21512.

(NOTE: This test can be made only when the system is operating properly.)

a. Place Amplifier switch in SENSOR position.

b. Place Sensor switch in MID position.

c. Adjust temperature dial until tester meter reads on SET line. Temperature dial should read 71°.

d. If temperature dial does not read 71°, adjust dial as described in Note 49b.

7. Shut off engine and remove Automatic Climate Control Tester from system and connect car wiring harness to amplifier connector.

8. Intermittent Conditions

a. Connect the positive lead of an accurate voltmeter to the transducer wire at the transducer connector. Ground the negative lead to the car body.

b. Allow system to operate and stabilize.

c. Tap the sensors, temperature dial and amplifier. A severe rap is necessary. Jiggle wires to the various units.

d. Watch the voltmeter for any sharp variation in the meter reading. Note the operation of the system.

e. If a variation occurs when a unit is tapped, check that unit for weak connections. Repair connections as necessary.

b. Automatic Temperature Control Tester, J-22368-01

This procedure is designed to assist servicemen in locating a malfunction in the Automatic Climate Control system. If the system is operating incorrectly, but does have some degree of self-modulation, first check adjustment of temperature dial as described in step 7. If system still performs incorrectly, proceed with listed tests.

For positive results, the Automatic Climate Control system should be tested in an area where the ambient temperature is between 70°F and 80°F. If the ambient temperature is below 70°F, the system may not produce full air conditioning, or if above 80°F, the system may not produce full heat.

1. Preliminary Test

a. Place Transmission in PARK and start engine.

b. Disconnect vacuum hose from power servo vacuum power unit, and seal hose with thumb. System and power servo should go to full air conditioning.

c. Connect a vacuum hose from vacuum supply line to power servo vacuum power unit. System and power servo should go to full heat. Reinstall vacuum hoses.

d. If system and power servo performed properly in steps b and c, proceed to step 3.

e. If power servo performed properly, but system did not, in steps b and c, proceed to step 6.

f. If power servo and system failed to perform properly, proceed to step g.

g. Check power servo and temperature door for binding or other mechanical interference. If no mechanical interference is found, replace power servo unit.

h. If system failed to turn on, proceed to step 2.

2. Source Test

a. Turn off engine if still operating and connect Automatic Temperature Control Tester, J-22368-01, as described in Note 53.

b. Turn system ON and set temperature dial to 71° setting.

c. With transmission in PARK position, start engine.

d. Place rocker switch on Automatic Temperature Control Tester, J-22368-01 in MANUAL position.

e. Turn voltage knob to SOURCE position.
f. Set manual control knob to 150 position.
g. Tester meter should read battery voltage.
h. If meter does not read battery voltage, check the power supply wires for shorts, grounds or opens. Check for blown fuse. The tester may be used for checking the wiring by turning the voltage knob to PROBE position and using the red probe.
i. If meter read battery voltage in step g, proceed to step 3.

3. Sensor String Test (Opens)
a. Place rocker switch in MANUAL position.
b. Turn voltage knob to SENSOR position.
c. Set manual control knob to 150 position.
d. Tester meter should read battery voltage.
e. If meter read battery voltage in step d, proceed to step 4.
f. If meter did not read battery voltage in step d, visually inspect in-car sensor, replace if apparently defective, and check operation of system.
g. Check for loose connector at duct sensor and then at ambient sensor. If loose connector is found, repair and check operation of system.
h. If an ohmmeter is available, measure resistance value of ambient sensor, duct sensor and then in-car sensor. Sensor resistance value should approximate resistance value given in Fig. 1-53. Replace any defective sensor located. If no defective sensor is found, check car wiring.
i. If an ohmmeter is not available, substitute a known good ambient sensor, duct sensor, and then in-car sensor; check operation of system after each substitution. If system still fails to perform satisfactorily, check car wiring.

4. Amplifier Test

(NOTE: Sensor string must be tested before testing amplifier.)

a. Place rocker switch in MANUAL position.
b. Turn voltage knob to AMPLIFIER OR CONTROL CAL. position.
c. Turn manual control to MAX. HEAT position.
d. Meter should read from 0 to 4 volts.
e. Turn manual control to MAX. COLD position.
f. Meter should read 8 volts minimum.
g. If steps c through f do not result in correct readings, proceed to step i.
h. If proper readings were achieved in steps c through f, proceed to step 5.
i. Disconnect red wire from temperature dial rheostat terminal. With wire open, system should go to full air conditioning. Meter should read 8 volts minimum.
j. Ground red wire. System should go to full heat, meter should read 0-4 volts.
k. If system performed properly in steps i and j, replace temperature dial rheostat.
l. If system failed to perform properly in steps i and j, replace amplifier circuit board.
m. If system fails to work properly after replacing amplifier circuit board, check car wiring.

5. Transducer Test
a. Place rocker switch in MANUAL position.
b. Turn voltage knob to TRANSDUCER position.
c. Turn manual control to MAX. COLD position.
d. Tester meter should read 8 volts minimum and vacuum gage should read 0-3 inches vacuum. Maximum blower should be achieved.
e. Turn manual control to MAX. HEAT position.
f. Tester meter should read 0-4 volts and vacuum gage should read 9 inches minimum vacuum. Maximum blower should be achieved.
g. If proper readings are not obtained in steps c through f, check wiring to transducer circuit for shorts, grounds or opens. Check for improperly grounded transducer. Replace transducer.

6. System Vacuum Test
a. Tee in a vacuum gage to any nipple of the master switch, and position vacuum gage so that it can be read from the seat.
b. Set the temperature dial to 70° and start engine. Vacuum gage should read above 14 inch Hg. at idle and stay at this setting throughout the check.
c. Slowly rotate temperature dial to 85°, and then back to 65°. If the temperature dial is rotated too rapidly, the vacuum may drop to 9 inch Hg. or so, but it should return to the original setting. This is a normal condition. However, if a vacuum leak is present, the vacuum reading will drop to 6 inch Hg. or less and remain there.

(NOTE: It is possible that a vacuum leak may show up only at a particular setting of the temperature dial. Therefore, whenever the vacuum drops, immediately stop rotating the dial until you are certain whether a leak is present or whether you were turning the dial too fast.)

d. Rotate temperature dial back to 71° setting. Vacuum reading should always be above 14 inch Hg., except in OFF position, where there should be no vacuum reading.
e. If a vacuum leak is present, determine when it is present. Then, referring to Fig. 1-109 and 1-110 determine what valves, hoses and vacuum power units are involved to locate leak.

7. Temperature Dial Test with Automatic Temperature Control Tester, J-22368-01.
a. Place rocker switch in MANUAL position.
b. Set voltage knob to AMPLIFIER OR CONTROL CAL. position.
c. Set manual control to 138 position.
d. Rotate temperature dial until tester meter indicates 6.5 volts.
e. Temperature dial should indicate 75°F.
f. If temperature dial does not indicate proper setting, adjust temperature dial as indicated in Note 55b.

8. Operational Test (697 ONLY)
a. This procedure is to be used when testing the rear system on the Fleetwood Seventy-Five. The tester should be connected to the system as described in Note 55 for rear system. Both systems should be turned ON, the front system should be operating in AUTO. The temperature dials should be set at 75°.
b. Position rocker switch in AUTOMATIC position.

c. Set voltage knob to AMPLIFIER OR CONTROL CAL. position.

d. Set manual control to 150 position.

e. Allow five minutes for systems to stabilize with doors and windows closed.

f. Meter should read 5.5 - 7.5 volts.

g. If improper reading is obtained in step f, check for shorted sensor.

h. If proper reading is achieved in step f, tap sensors and amplifier.

i. If meter needle jumps when a unit is tapped, check that unit for weak connections that will cause an intermittent defect in system.

j. If proper reading is achieved in step f, with no movement of the needle in step i and all steps in part steps 1-7 have been completed, system is operating properly.

k. Shut off engine and remove Automatic Temperature Control Tester, J-22368-01 from system. Connect car wiring harness connector to amplifier connector and large vacuum hose to transducer. Install any trim items removed.

c. Temperature Dial Operational Test

(NOTE: This test is performed without the Automatic Temperature Control Tester, J-22368-01, or Automatic Climate Control Tester, J-21512. Although it is less efficient it allows for the tailoring of a system to meet the requirements of an individual owner.)

a. Using masking tape, suspend a thermometer from headliner so that bulb hangs at breath level over front passenger's seat.

b. Suspend a second thermometer at breath level midway between the rear roof outlets.

c. Position auxiliary fan (approximately 24 inch dia. blades) so that air stream is directed towards air intake grille.

d. Close all doors and windows.

e. Set both temperature dials to 75°.

f. With shift lever in PARK position, start engine and operate at 900 rpm.

g. Making certain that all air conditioner outlets are open, adjust as follows:

1. Front end outlets so that air is directed toward doors.

2. Front center outlet so air is directed toward top of front seat.

3. Rear roof outlet diverter doors should be opened.

(NOTE: Outlet air must not be directed toward thermometers.)

h. Allow systems to operate for 25 minutes for stabilization, then record reading from suspended thermometers.

i. If thermometers vary from 75° setting, adjust temperature dials to coincide with nearest thermometer reading, as indicated in Note 51b.

55. Automatic Climate Control Panel (697 Rear)

a. Removal

1. Remove rear seat cushion by lifting forward edge and pulling forward.

2. Remove rear seat back by removing two screws along lower edge and lifting assembly of mounting hooks.

3. Remove six screws securing right armrest to trim panel and remove armrest.

4. Remove trim pad from right side panel for access to back of panel.

5. Remove radio controls as described in Section 12, Note 68a, Steps 12 and 13.

6. Remove electrical connectors from temperature dial and master "ON-OFF" switch.

7. Remove two screws securing control panel to trim pad and remove control panel.

b. Installation

1. Position control panel to trim pad and secure with two screws.

2. Connect electrical connectors at master "ON-OFF" switch and temperature dial.

3. Install radio controls as described in Section 12 Note 68b, Steps 5 and 6.

4. Reposition trim pad and install in position on quarter panel.

5. Position armrest against quarter panel and secure with six screws.

6. Install rear seat back on mounting hooks and secure with two screws.

7. Install rear seat cushion.

56. Air Conditioner Control Panel Disassembly and Assembly

a. Temperature Dial Rheostat Removal

1. Remove control panel as described in Note 55a.

2. Disconnect electrical connector inside arm rest.

3. Remove two screws securing rheostat to control panel and remove rheostat.

b. Temperature Dial Rheostat Installation

1. Position rheostat to control panel and secure with two screws.

2. Connect electrical connector.

3. Install control panel as described in Note 55b.

4. Adjust temperature dial as described in Note 49b.

c. Control Switch Removal

1. Remove control panel as described in Note 55a.

2. Disconnect black and yellow hoses from control switch.

3. Remove two screws and remove switch.

d. Control Switch Installation

1. Position switch to control panel and secure with two screws.

2. Connect black and yellow hoses to ports as indicated by color coding dots on switch assembly.
3. Install control panel as described in Note 55b.

57. Amplifier (697 Rear)

a. Removal

1. Remove trim panel inside luggage compartment.
2. Remove multiple connector from amplifier terminals.
3. Disconnect red wire at single connector.
4. Remove spring clip securing multiple connector to mounting plate.
5. Remove screw securing amplifier circuit board to mounting plate.

b. Installation

1. Position amplifier circuit board to mounting plate and install screw securing circuit board to mounting plate.
2. Install spring clip securing multiple connector to mounting plate.
3. Connect red wire at single connector.
4. Connect multiple connector to amplifier terminals.
5. Install trim panel inside luggage compartment.

58. In-Car Sensor (697 Rear)

a. Removal

1. Snap protective grille off in-car sensor on package shelf inside car.
2. Remove two screws securing sensor to package shelf.
3. Disconnect in-car sensor from electrical connector.
4. Carefully remove in-car sensor.

b. Installation

1. Connect in-car sensor to electrical connector.
2. Position in-car sensor on package shelf.
3. Secure in-car sensor to package shelf with two screws.
4. Snap protective grille over in-car sensor on package shelf.

59. Ambient Sensor (697 Rear)

Refer to Note 24 for replacement of the ambient sensor.

60. Duct Sensor (697 Rear)

a. Removal

1. Remove trim panel inside luggage compartment.
2. Disconnect electrical connector from sensor terminals.
3. Remove two screws securing sensor to right mode door assembly and remove sensor.

b. Installation

1. Position sensor to right mode door assembly and secure with two screws.
2. Connect electrical connector to sensor terminals.
3. Install trim panel inside luggage compartment.

61. Water Control Valve (697 Rear)

(NOTE: The water control valve and thermal vacuum valve are serviced as an assembly.)

a. Removal

1. Remove trim panel inside luggage compartment.
2. Pinch off valve inlet and outlet water hoses.
3. Position shallow pan under water control valve to catch any coolant that may spill.
4. Remove clamps securing hoses to valve, and remove water hoses.
5. Remove vacuum hoses from thermal vacuum valve, and remove vacuum hose from water control valve vacuum power unit.
6. Remove horseshoe spring retainer clip securing valve to mounting bracket and remove valve.

b. Installation

1. Position water control valve to mounting bracket and secure with horseshoe spring retainer clip.
2. Install water hoses on valve inlet and outlet fittings and install clamps on hoses.
3. Remove clamps pinching off hoses.
4. Install vacuum hoses on thermal vacuum valve.

(NOTE: Yellow striped hose connects to vacuum nipple closest to water outlet fitting.)

5. Connect red striped vacuum hose to water control valve vacuum power unit.
6. Install trim panel inside luggage compartment.
7. Replace any coolant lost.

62. Blower Resistor (697 Rear)

a. Removal

1. Remove trim panel inside luggage compartment.
2. Remove multiple connector from blower resistor.
3. Remove single connector from blower resistor.
4. Remove two screws securing blower resistor to bottom of case assembly.
5. Remove blower resistor from bottom of case assembly.

b. Installation

1. Position blower resistor into bottom of case assembly.
2. Secure resistor to case assembly with two screws.
3. Install single connector on blower resistor.
4. Install multiple connector on blower resistor.
5. Install trim panel inside luggage compartment.

63. Blower Motor Assemblies (697 Rear)

This procedure applies to both right and left blower motors.

a. Removal

1. Remove trim panel inside luggage compartment.
2. Disconnect double connector at motor to be removed. Connector is located in front of motor.
3. Pull back rubber material from screw heads and remove five screws securing blower motor to blower housing.
4. Remove blower and fan assembly.

b. Installation

1. Position blower motor and fan assembly in blower housing and secure with five screws, and replace rubber insulating material.
2. Connector double connector.
3. Install trim panel inside luggage compartment.

64. Master Switch (697 Rear)

a. Removal

1. Remove trim panel inside luggage compartment.
2. Disconnect vacuum hoses from master switch.
3. Disconnect electrical connector from master switch.
4. Remove screw securing master switch mounting bracket to case and remove master switch and mounting bracket.
5. Separate mounting bracket from master switch.

b. Installation

1. Install mounting bracket on master switch.
2. Position master switch mounting bracket to case and install screw securing mounting bracket to case.
3. Connect electrical connector to master switch.
4. Install vacuum hoses to master switch.
5. Install trim panel inside luggage compartment.

65. Power Servo (697 Rear)

a. Removal

1. Remove trim panel inside luggage compartment.
2. Disconnect multiple electrical connector from power servo.
3. Disconnect multiple vacuum connector from servo valve.
4. Disconnect vacuum hose from power servo vacuum power unit.
5. Disconnect temperature door link at temperature door arm.
6. Remove two screws securing power servo to case.
7. Remove power servo.

b. Installation

1. Position power servo into opening in case and secure with two screws.
2. Connect vacuum hose to power servo vacuum power unit.
3. Connect multiple vacuum connector to servo valve.
4. Connect multiple electrical connector.
5. Connect temperature door link and adjust as described in Note 55a.
6. Replace trim panel inside luggage compartment.

66. Power Servo Vacuum Valve (697 Rear)

a. Removal

1. Disconnect multiple hose connector.
2. Remove spring clip and one screw securing vacuum valve to power servo.
3. Remove vacuum valve.

b. Installation

1. Position vacuum valve on power servo and secure with one screw and spring clip.
2. Connect multiple hose connector.

67. Mode Door Assemblies

This procedure applies to both right and left mode door assemblies.

a. Removal

1. Remove trim panel inside luggage compartment.
2. Remove duct sensor electrical connector from right mode door assembly only.
3. Remove vacuum hose from mode door vacuum diaphragm.
4. Remove three nuts securing de-fogger duct to outlet grille on package shelf.
5. Loosen clamps securing mode door assembly to blower assembly, heater discharge and air conditioner discharge hoses.
6. Slide discharge hoses off of mode door assembly and lift assembly off of blower outlets.

b. Installation

1. Install mode door vacuum hose on diaphragm.
2. Position mode door assembly on blower outlet.
3. Position heater discharge and air conditioner discharge hoses on mode door assembly.
4. Secure mode door assembly on blower assembly by tightening clamp.
5. Secure heater discharge and air conditioner discharge hoses onto mode door assembly by tightening clamps.
6. Position de-fogger ducts to outlet grille on package shelf, retaining with three nuts.
7. Install duct sensor electrical connector into right mode door assembly only.
8. Install trim panel inside luggage compartment.

68. Transducer (697 Rear)

a. Removal

1. Remove trim panel inside luggage compartment.
2. Disconnect vacuum hoses from fittings on transducer.

3. Disconnect transducer electrical connector.
4. Remove two screws securing transducer mounting bracket to power servo and remove transducer.

b. Installation

1. Position transducer to power servo and secure with two screws.
2. Connect transducer electrical connector.
3. Connect vacuum hoses to fittings on transducer.

(NOTE: Vacuum hose with smallest I.D. goes on top fitting of transducer.)

4. Replace trim panel inside luggage compartment.

69. Compressor Diode Assembly (697 Only)

The procedure for removing and installing the compressor diode assembly is described in Section 12, Note 70.

70. Blower Evaporator Assembly (697)

a. Removal

1. Remove trim panel inside luggage compartment.
2. Purge system as described in Note 46a.
3. Drain engine cooling system.
4. Raise rear of car and remove clamp securing evaporator drain and remove drain.
5. Disconnect right and left mode door assemblies from blower motors and disconnect tan vacuum hoses.
6. Disconnect ambient air hoses from blower evaporator assembly.
7. Disconnect ambient and duct sensor leads.
8. Disconnect heater supply and return hoses, air conditioner high and low pressure hoses, and vacuum supply hose at connector where they enter luggage compartment below blower evaporator assembly.
9. Disconnect six way electrical connector from body wiring at right side of car.
10. Disconnect yellow and black vacuum hoses at right side of car.
11. Unsnap return air boot from blower evaporator assembly.
12. Remove screw securing bracket to package shelf.
13. Remove four screws securing brackets to floor pan.
14. Lift blower evaporator assembly out of luggage compartment.

b. Installation

1. Position blower evaporator assembly in luggage compartment.
2. Connect right and left mode door assemblies to blower evaporator outlets.
3. Connect tan vacuum hoses.
4. Connect return air boot to blower evaporator case.
5. Connect yellow and black vacuum hoses at right side.
6. Connect six-way electrical connector at right side.
7. Connect heater supply and return hoses, air conditioner high and low pressure hoses, and vacuum hose at connectors under blower evaporator assembly. Refer to Fig. 1-101. Recover low pressure hose with insulation.
8. Connect ambient and duct sensor leads.
9. Connect ambient air hoses to blower evaporator.
10. Secure lower brackets to floor pan with four cap screws.
11. Secure upper bracket to package shelf with screw.
12. Raise rear of car and install evaporator drain assembly.
13. Fill engine cooling system.
14. Evacuate system as described in Note 46c.
15. Charge system as described in Note 46d.
16. Replace trim panel inside luggage compartment.

71. POA Suction Throttling Valve (697 Rear)

a. Removal

1. Remove blower evaporator assembly as described in Note 70a.
2. Remove screw securing suction throttling valve clamp to case assembly.
3. Disconnect equalizer line.
4. Disconnect low pressure line form suction throttling valve.
5. Disconnect suction throttling valve from evaporator outlet pipe.

b. Installation

1. Connect suction throttling valve to evaporator outlet pipe.
2. Connect low pressure line to suction throttling valve, and cover with insulation.
3. Connect equalizer line to suction throttling valve.
4. Secure suction throttling valve to case assembly with clip and one screw.
5. Install blower evaporator assembly as described in Note 70b.

72. Evaporator Core

a. Removal

1. Remove blower evaporator assembly as described in Note
2. Remove 29 screws and 4 nuts holding evaporator case together and remove bottom of case.
3. Remove screw and clamp securing high pressure line to bottom of case assembly.
4. Disconnect suction throttling valve from evaporator outlet pipe.
5. Disconnect equalizer line from suction throttling valve.
6. Remove ambient air inlet fittings from case.
7. Remove four screws on top of case securing evaporator core to case and remove evaporator core from case.

8. Remove expansion valve from evaporator core as described in Note 73a.

b. Installation

1. Install expansion valve to evaporator core as described in Note 73b.
2. Position evaporator core in case assembly and secure with four screws.
3. Install ambient air inlet fittings on case.
4. Connect suction throttling valve to evaporator outlet pipe.
5. Connect equalizer line to suction throttling valve.
6. Position bottom of case on assembly and secure with 29 screws and 4 nuts.
7. Secure high pressure line to bottom of case with clamp and screw.
8. Install blower evaporator assembly as described in Note 70b.

73. Expansion Valve

a. Removal

1. Remove blower evaporator assembly as described in Note 70a.
2. Remove evaporator core assembly as described in Note 72a.
3. Remove power element bulb from evaporator outlet pipe.
4. Disconnect equalizer line from POA suction throttling valve.
5. Disconnect expansion valve from evaporator inlet.

b. Installation

1. Connect expansion valve to evaporator inlet.
2. Connect equalizer line to suction throttling valve.
3. Position power element bulb on evaporator outlet and secure.
4. Replace evaporator core assembly as described in Note 72b.
5. Replace blower evaporator assembly as described in Note 70b.

74. Heater Core

a. Removal

1. Remove blower evaporator assembly as described in Note 70a.
2. Remove inlet and outlet hoses from heater inlet and outlet pipes.
3. Remove 29 screws and 4 nuts securing evaporator case together.
4. Remove clamp and screw securing high pressure line to bottom of case.
5. Remove sealing grommet around heater inlet and outlet pipes.
6. Remove 6 screws securing temperature door baffle to case and remove baffle.
7. Remove 6 screws, 3 each side of case, securing heater core and baffle to case.
8. Lift heater core and baffle from case.
9. Remove 4 screws securing baffle to heater core and remove baffle.
10. Remove retainers from heater core.

b. Installation

1. Position retainers to heater core and secure baffle to retainers with 4 screws.
2. Position heater core in case and secure with 6 screws, 3 each side.
3. Install temperature door baffle.
4. Seal hole around heater inlet and outlet pipes with sealing grommet.
5. Position bottom of case on assembly and secure with 29 screws and 4 nuts.
6. Secure high pressure line to bottom of case with clamp and screw.
7. Install inlet and outlet hoses to heater core pipes.
8. Install blower evaporator assembly as described in Note 70b.

THEORY OF OPERATION

HEATER ONLY—ALL SERIES

The Cadillac standard heater system uses the air mix principle of heat regulation.

The heating system, Fig. 1-114, incorporates a blower assembly mounted on the right-hand side of the cowl in the engine compartment and a heater assembly located on the cowl but inside the car under the instrument panel. These units provide heated air for the front and rear passenger compartments and to the windshield for defrosting and defogging.

Outside air is drawn through the cowl vent duct into the blower assembly. The blower provides air which may be directed to go through the heater core or by-pass the heater core. The desired discharge temperature is obtained by mixing the heated air with the unheated air in the necessary proportions. The temperature of the air discharged into the passenger compartment is controlled by the temperature door inside the heater assembly. This door is operated by a cable connected to the temperature lever on the control head. With the temperature lever in the On setting, no air is directed through the heater core. With the temperature lever all the way to the right, no air is allowed to by-pass the heater core.

The defroster door and the diverter door are located on the heater assembly.

The diverter door is located near the right-hand end of the heater assembly. Whenever the heater control is in the "On" position, the diverter door vacuum actuator is vented, the diverter door seals against the diverter door

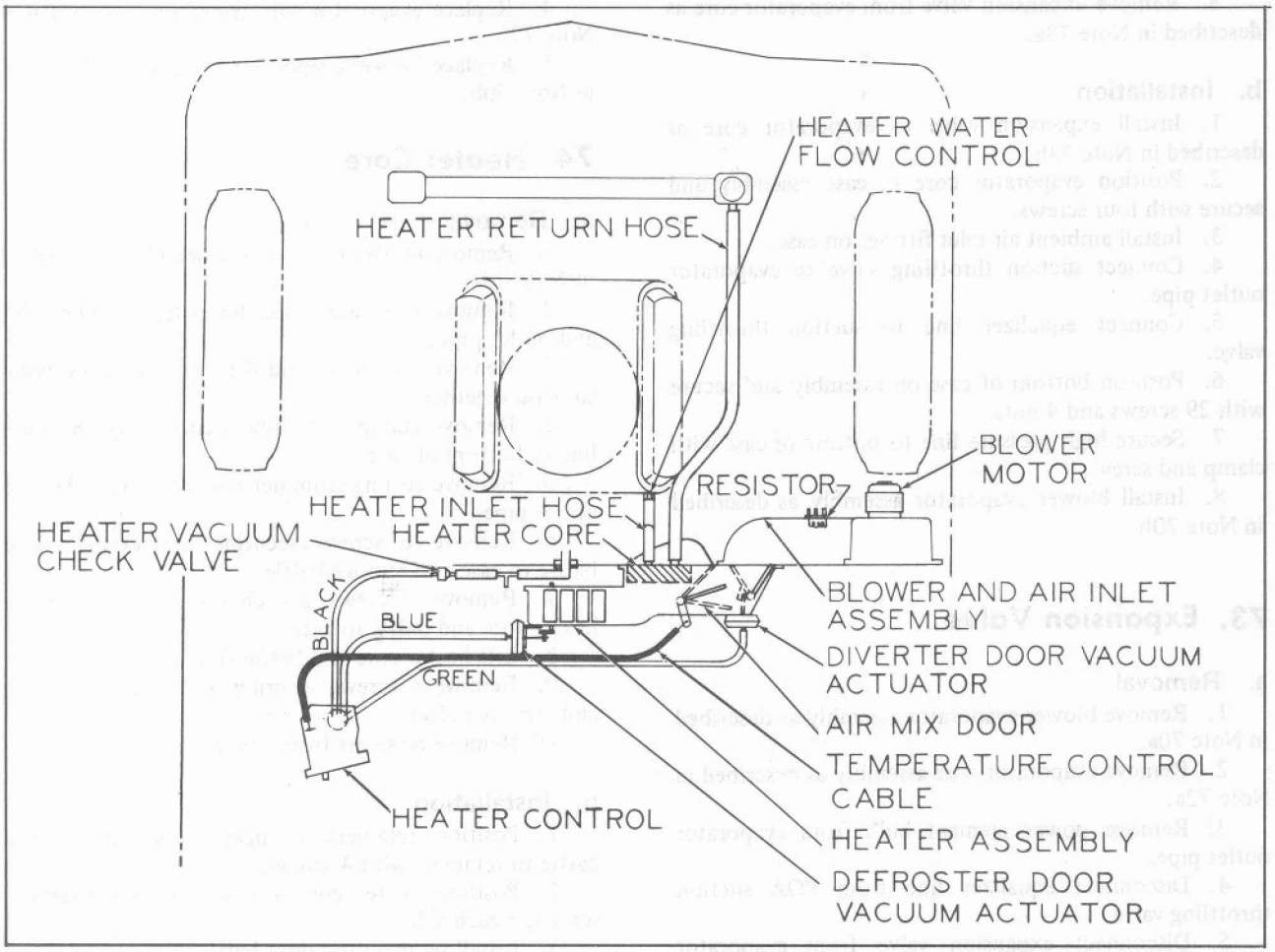


Fig. 1-114 Heater Components

opening and air is allowed to flow into the heater assembly for heating and defrosting, Fig. 1-115. With the heater control in the "Off" position, vacuum is applied to the diverter door vacuum actuator. The diverter door is then positioned to seal off air flow through the heater assembly and divert air into the car through the diverter door opening, under the instrument panel at the right side of the car. Since the blower motor operates whenever the ignition is on, this provides positive air flow into the car when the heater control is in the "Off" position.

The heater control panel, Fig. 1-116, is located in the instrument cluster to the left of the steering column. The fan switch provides three speeds - low, medium and high.

With the temperature lever in the On position, advancing the HEAT-DEFROST lever to the HEAT position vents the vacuum operated defroster door, Fig. 1-114, opening it to provide air to the heater outlet. From the heater outlet the air is distributed around the front floor and under the seat to the rear floor. With the door in this position, a small portion of the discharge air is directed to the windshield through the defroster outlets.

Moving the HEAT-DEFROST lever to the DEFROST position supplies vacuum to the defroster door vacuum actuator and positions the defroster door such that most of the discharge air is directed to the windshield, Fig. 1-114, while the remaining discharge air is directed to the heater outlet. In all positions of the HEAT-DEFROST lever, the fan switch controls the three blower speeds.

The air flow paths as described above are shown in Fig. 1-115.

All Cadillacs with the heater only system are equipped with a variable restrictor at the heater outlet fitting on the cylinder head water feed nipple. This restrictor serves to regulate both water flow and water pressure to the heater core as the pressure in the engine cooling system rises due to increasing engine speed.

Ventilation

On cars not equipped with air conditioning an upper level - lower level ventilation system is provided to circulate outside air through the passenger compartment. Ventilating air enters the car through an opening at the base of the windshield and is discharged into the passenger compartment either through grilles near the cowl side trim panels (lower level) or through a grille in the instrument panel, (upper level). Air exhaust grilles are incorporated into each door lock pillar to allow air to leave the car, providing positive air flow even when windows are closed.

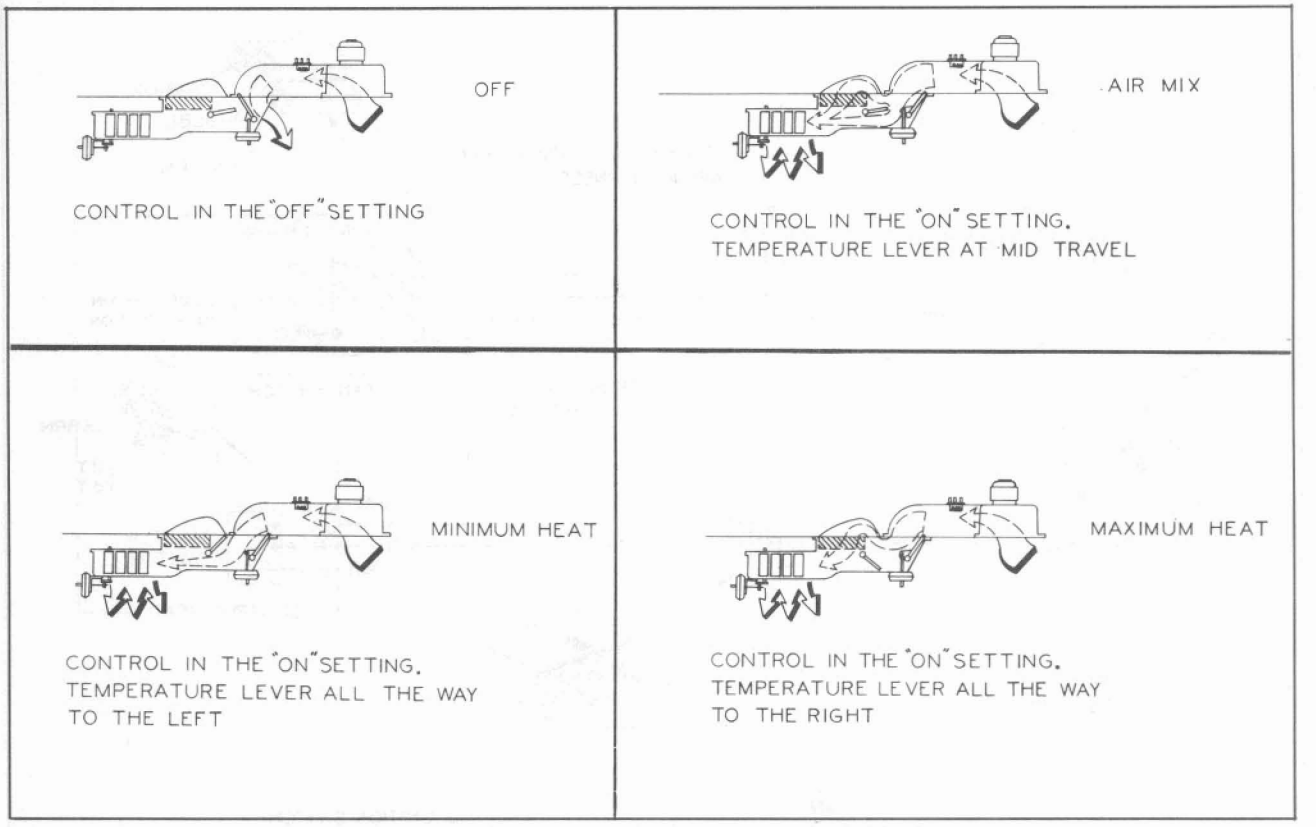


Fig. 1-115 Heater Air Flow

Separate control knobs for the low level ventilation outlets are located in the cowl side trim panels. The control for the upper level ventilation is located at the centerline of the car on the steering column lower cover. Pulling out the knobs opens air doors which admit air to the grilles.

The knobs can be pulled out partially or all the way to admit as much as air as desired. The vanes in the center outlet on the instrument panel can be set to direct air to the right or left or up and down.

Electrical Circuit

The heater electrical circuit is illustrated in Fig. 1-117, the current flows from the battery through the ACC terminal of the ignition switch, and through a 15 ampere fuse to the master ON-OFF switch, located on the control panel. When the master switch is closed, current flows to the blower control switch, through the blower resistor, to the blower motor, and to ground.

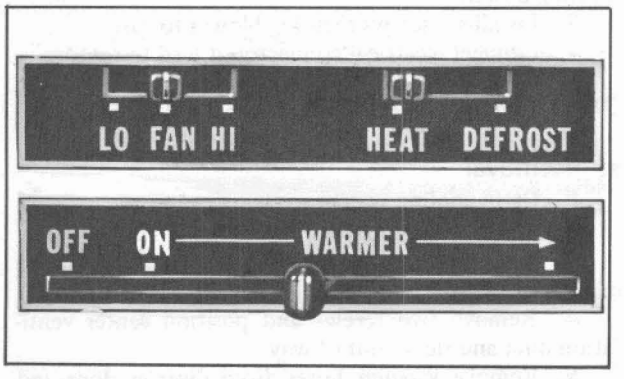


Fig. 1-116 Heater Control Panel

75. Upper Level Ventilation Door Adjustment

(NOTE: There is no adjustment for the lower level ventilation door.)

Loosen screw that secures upper level ventilation door bowden cable clamp and position bowden cable so that door fully closes when knob is pushed all the way inward.

76. Heater Control Panel

The procedure for removing and installing the Heater Control Panel assembly is described in Section 12, Note 75.

77. Blower Resistor

a. Removal

1. Disconnect electrical connector to blower resistor at heater blower assembly.
2. Remove two screws and resistor from heater-blower assembly.

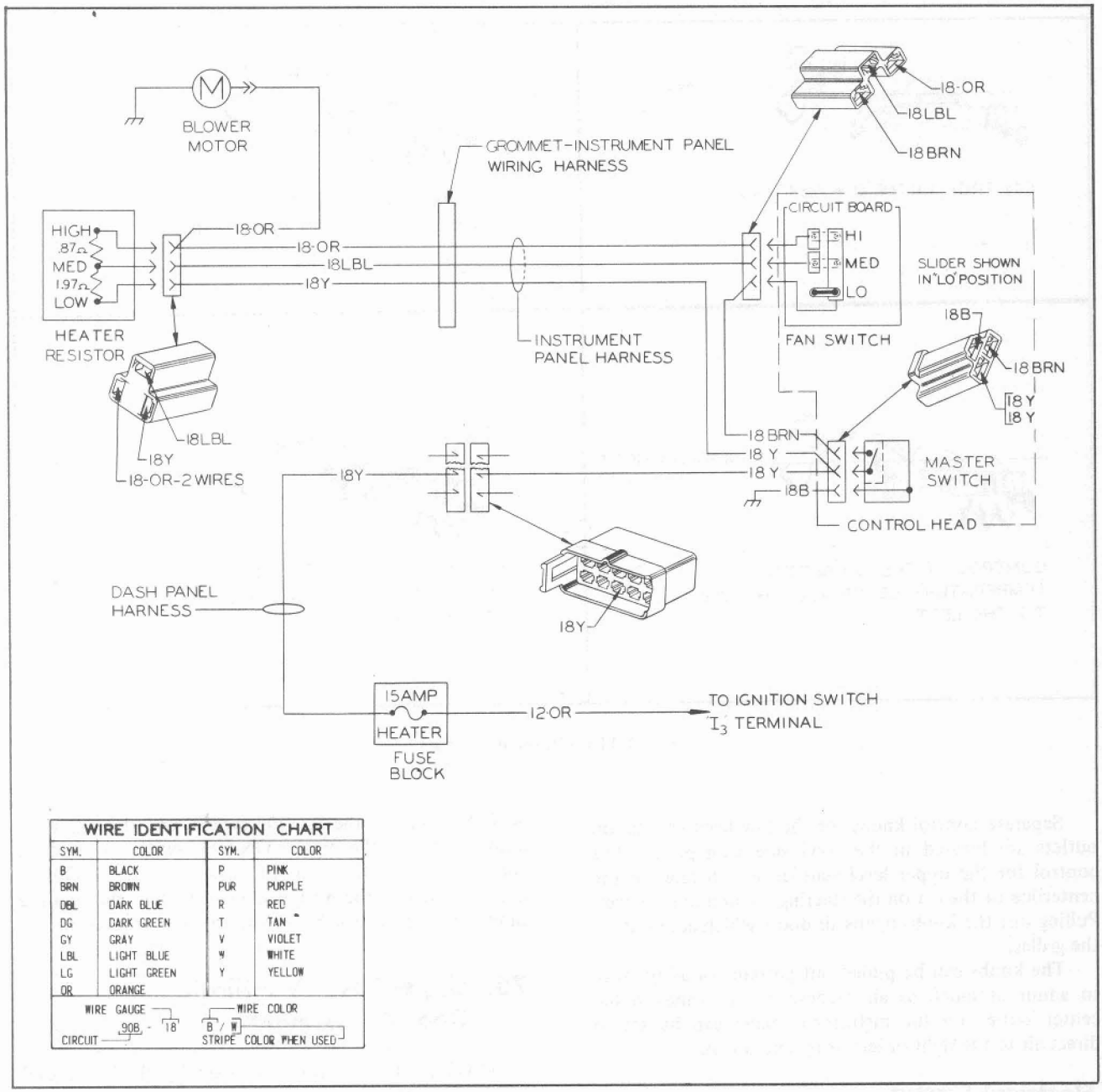


Figure 1-117 Heater Electrical Circuit

b. Installation

1. Position blower resistor on heater blower assembly and secure with two screws.
2. Connect electrical connector at blower resistor.

78. Heater Blower Motor

a. Removal

1. Disconnect electrical connector at lead to motor.
2. Remove five screws securing blower to case and remove blower.

b. Installation

1. Place bead of sealer around opening where blower will contact case.
2. Guide blower motor against cowl and place on locating dowel.
3. Install six screws securing blower to case.
4. Connect electrical connector at lead to motor.

79. Heater Case

a. Removal

1. Drain cooling system.
2. Remove heater hoses from heater core nipples.
3. Remove instrument panel top cover as described in Section 12, Note 71a.
4. Remove two screws and position center ventilation duct and sleeve out of way.
5. Remove vacuum hoses from diverter door and defroster door vacuum actuators.

6. Remove bowden cable from temperature door arm and remove screw securing cable to heater case. Reposition cable out of way.

7. Remove two screws and two nuts securing heater case to cowl and pull case away from cowl.

8. Remove heater case from position under instrument panel, being careful to hold case as upright as possible to avoid spilling coolant from heater core nipples on carpet.

b. Installation

1. Position heater case under instrument panel and move into position on cowl.

2. Working under hood, install two screws and two nuts securing heater case to cowl.

3. Install heater hoses to heater core nipples. Secure with clamps.

4. Refill cooling system.

5. Install bowden cable to temperature door and secure cable to case with one screw.

6. Install vacuum hoses to diverter door and defroster door vacuum actuators.

7. Position center ventilation duct and secure with two screws. Install rubber sleeve between duct and outlet.

8. Install instrument panel top cover as described in Section 12, Note 71b.

80. Heater Core

a. Removal

1. Remove case as described in Note 79a.

2. Remove two screws and retainer at each side of core securing core to case and remove core.

3. Remove rubber grommet from heater core water nipples.

b. Installation

1. Install rubber grommet around water nipples and position core in heater case.

2. Position retainers at ends of core and secure with two screws.

3. Install heater case as described in Note 79b.

TORQUE SPECIFICATIONS— METAL TUBING

Metal Tube O.D. (Inch Lbs.)	Steel Tubing Torque (Ft. Lbs.)	Alum. or Copper Tubing Torque (Ft. Lbs.*)
1/4"	15	7
3/8"	35	13
1/2"	35	13
5/8"	35	21
3/4"	35	28

*Torque taken with crow foot attachment at a 90° angle on torque wrench.

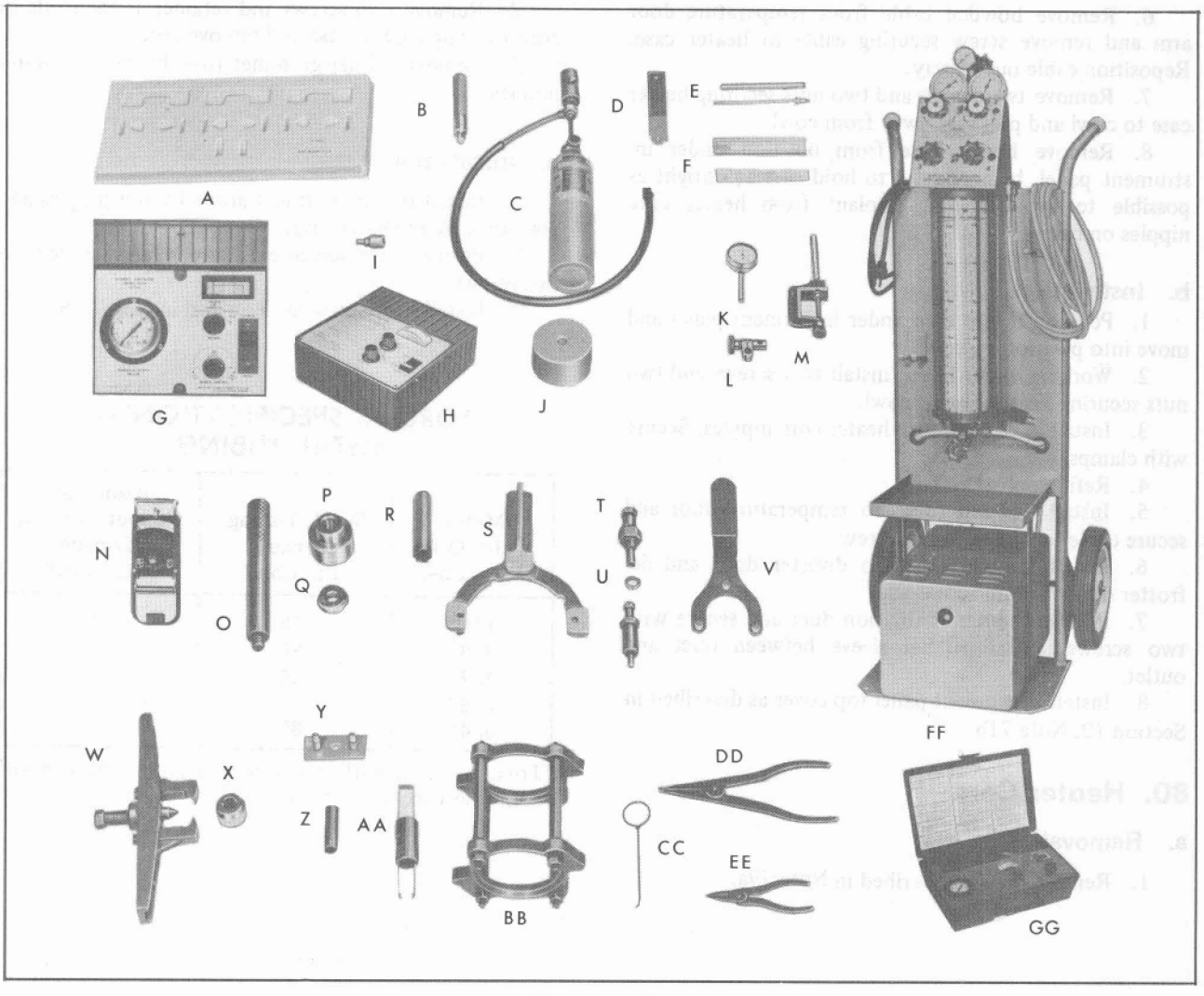


Fig. 1-118 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-9402	Parts Tray	R	J-9392	Seal Remover and Installer
B	J-9432	Needle Bearing Installer	S	J-9396	Holding Fixture
C	J-6084	Leak Detector Torch	T	J-9401	Clutch Plate and Hub Assembly Remover
D	J-21530	Temperature Dial Adjuster			
E	J-5421	Thermometer	U	J-9480	Clutch Plate and Hub Assembly Installer (2 Pieces)
F	J-6076	Humidicator			
G	J-21512	Automatic Climate Control Tester	V	J-9403	Clutch Hub Holding Tool
			W	J-8433	Pulley Puller
H	J-22368-01	Automatic Temperature Control Tester	X	J-9395	Puller Pilot
			Y	J-9527	Test Plate
I	J-5420	Gage Adapter (2 Required)	Z	J-9399	9/16" Thin Wall Socket
J	J-9521	Internal Assembly Support	AA	J-9393	Seal Seat Remover and Installer (2 pcs.)
K	J-8001-3	Dial Indicator			
L	J-8001-2	Sleeve	BB	J-9397	Compressor Fixture
M	J-8001-1	Clamp	CC	J-5139	Oil Pick-Up Tube Remover
N	J-23600	Tension Gage	DD	J-6435	Snap Ring Pliers (#26)
O	J-8092	Universal Handle	EE	J-5403	Snap Ring Pliers (#21)
P	J-9398	Pulley Bearing Remover	FF	J-23500	Charging Station
Q	J-9481	Pulley and Bearing Installer	GG	J-23678	A/C Tester

GENERAL DESCRIPTION

(NOTE: For information pertaining to the Eldorado (693) frame, refer to the latter portion of this section.)

A swept torque-box perimeter type frame, Fig. 2-1, is used on all 1972 model "C" series Cadillac automobiles. The frame is of fully boxed construction throughout its entire length. It encircles the passenger compartment with heavy side members, permitting a low front floor with adequate seat height. This frame design also allows a small floor tunnel, and simplifies propeller shaft arrangement. Diagonal strut rod supports and two braced cross members support the front suspension and the engine front mounts. The frame has two front cross members to provide a closer coupling of the front bumper to the frame. Two supports and a cross member are provided for the engine rear mount.

A center cross member is provided on the frames on Fleetwood Seventy-Fives and the Commercial Chassis to support the center bearing of the two-piece propeller shaft used on these models. This center cross member is located between the number 3 and number 4 body mounting locations.

The perimeter type frame used on the 1972 Commercial Chassis is similar to the passenger car frame; however, it has heavier construction features and incorporates a lower rear kick-up to meet the requirements of the flat floors used on commercial vehicles.

SERVICE INFORMATION

1. Body Mounts

Locations of the body mount holes on all 1972 model cars, are shown in Fig. 2-2. Cross sectional views of the parts required for installation of body mounts, showing the order of assembly, appear in Fig. 2-2. The code letters in the frame diagram and their corresponding cross sections indicate the installation required at the body mount locations for each 1972 body style.

The actual number of shims used may vary with each installation Fig. 2-2. Use the quantity necessary to fill the gap remaining between the body and frame after the recommended hardware is installed. The correct number of shims required at each mount location may be determined by attempting to rotate the pad between the body and the frame. If the pad can be rotated with the fingers, add body shims until pad can no longer be rotated.

2. Checking Frame For Twist

1. Place car on section of level floor, and inflate tires to proper pressure.
2. Measure distance from top of extreme front end of left side rail to floor. Repeat measurement for right side rail.
3. If front ends of right and left side rails are not the same distance from floor, raise low side rail with a jack until distances are equal.
4. Measure distance from extreme rear end of top of left rear side rail to floor. Repeat for right side rail.

3. Checking Frame Dimensions

Refer to frame checking locations, Fig. 2-3. The car should be on a flat, level floor to assure accurate measurements when either of the following methods are used.

The easiest and most accurate method of checking frame dimensions is by use of tram gages. When using tram gages, be sure to keep the gage cross bar level to insure accuracy in all measurements.

The "plumb bob" method may be used for measuring frame dimensions if tram gages are not available. Using this method, it is only necessary to have a piece of cord attached to an ordinary surveyor's plumb bob. When measuring the distance between two points, the free end of the cord should be placed at one of the points and a mark made on the floor exactly under the plumb bob. This operation should be repeated at the other point, and the distance between chalk marks on the floor may be easily measured.

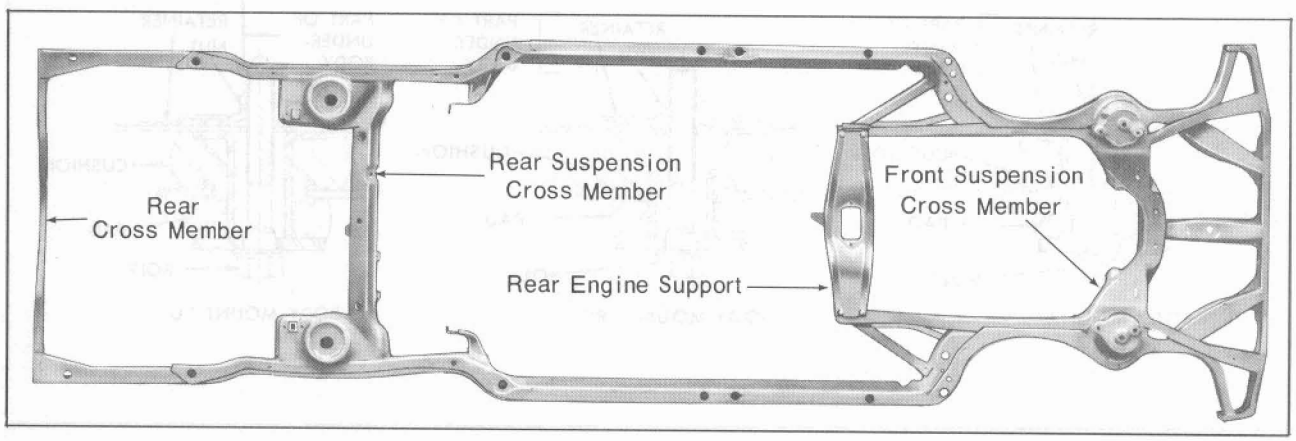
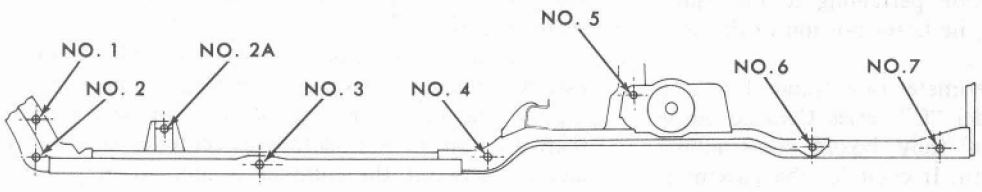
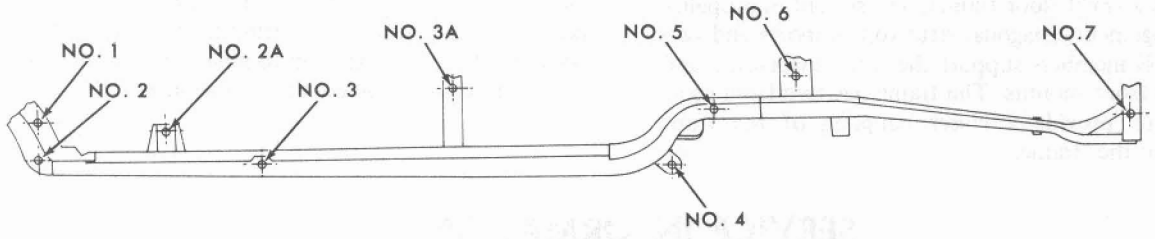


Fig. 2-1 Perimeter Frame (Except 693)



ALL MODELS EXCEPT COMMERCIAL

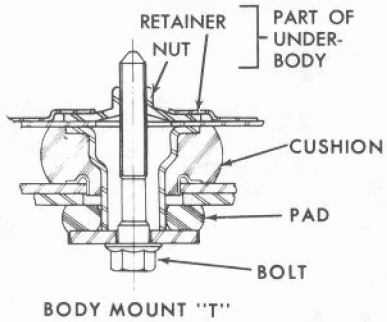


COMMERCIAL

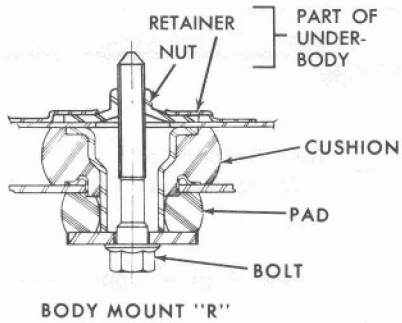
SERIES	NO. 1	NO. 2	NO. 2A	NO. 3	NO. 3A	NO. 4	NO. 5	NO. 6	NO. 7
ALL MODELS EXCEPT THOSE SHOWN BELOW	R	U	—	R	—	R	U	R	R
FLEETWOOD BROUGHAM 68169	R	U	—	R	—	R	U	R	R
FLEETWOOD SEVENTY-FIVE 69723-69733	R	U	R	R	—	R	U	R	R
COMMERCIAL 69890	R	R	R	T	R	R	R	R	R
FLEETWOOD ELDORADO 69347	R	R	—	—	—	R	R	R	R
FLEETWOOD ELDORADO CONVERTIBLE 69367	R	R	—	R	—	R	R	R	R

A SPECIAL SELF-TAPPING BODY-TO-FRAME BOLT, HAVING A "TAP TIGHT THREAD," IS RELEASED FOR SERVICE. IT ENABLES REPAIR OF STRIPPED THREADS IN BODY MOUNT "T" NUTS WITHOUT HAVING TO CUT HOLES IN THE FLOOR PAN TO REPLACE THE DAMAGED NUT.

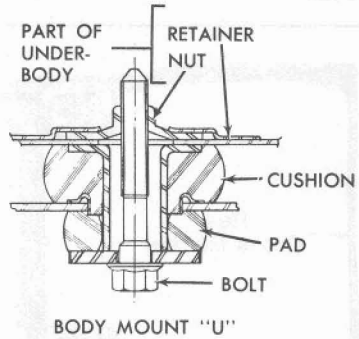
	SIZE	TIGHTEN TO
ALL BOLTS	7/16-14	45-60 FT. LBS.



BODY MOUNT "T"



BODY MOUNT "R"



BODY MOUNT "U"

Fig. 2-2 Body Mounts and Location (All Series)

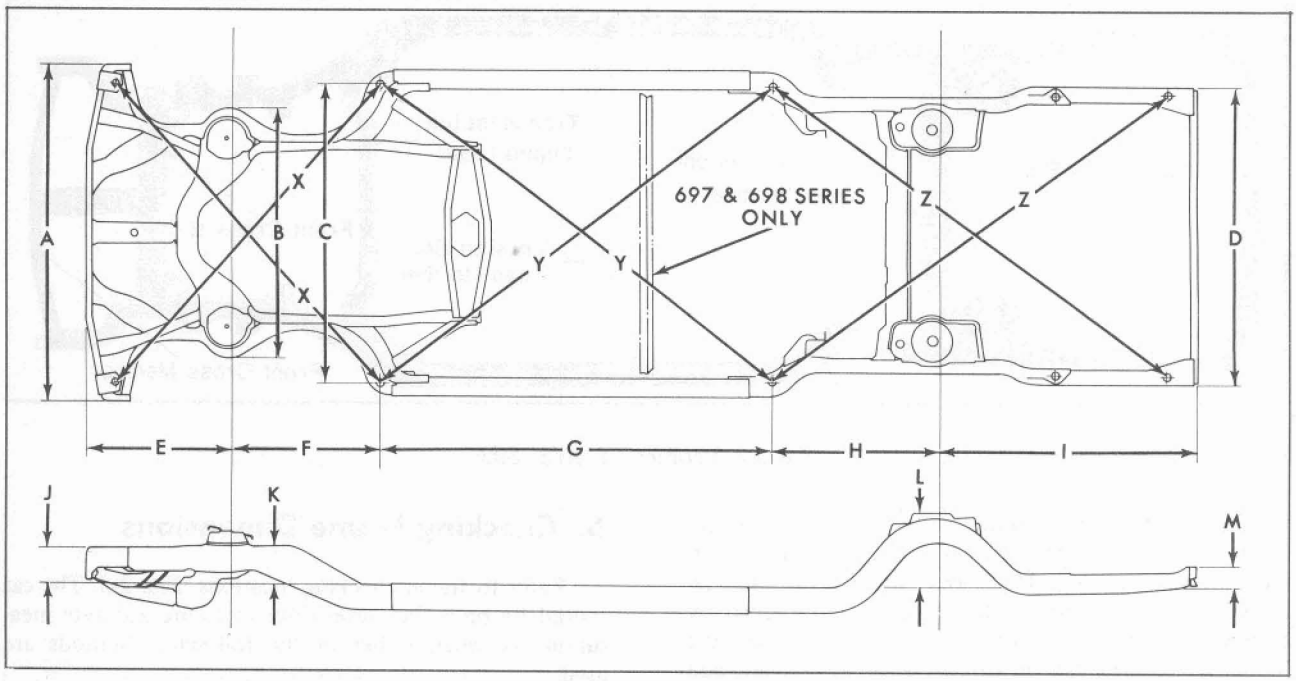


Fig. 2-3 Frame Checking Points (Except 693)

(NOTE: The following frame checking dimensions apply to all series except the 693 unless otherwise noted.)

A - Width of front cross member 62"

B - Width of frame at front suspension cross member: 46-1/8"

C - Outer #1 left location to outer #1 right location: 55-1/8"

D - Width of rear cross member 54-11/16". Commercial Chassis: 54-1/2"

E - Front vertical surface of front cross member to center line of front wheels: 26-5/8"

F - Center line of front wheel to outer #1 location: 27-7/64"

G - Outer #1 location to #4 location: 72-5/64", Commercial Chassis 101-13/32", Fleetwood Sixty Special Brougham 75-5/64", and Fleetwood Seventy-Five 93-37/64"

H - Number 4 location to center line of rear wheels: 30-13/16", Commercial Chassis 29"

I - Center line of rear wheels to rear vertical surface of rear cross member: 45-21/32", Commercial Chassis 45-1/4"

J - Height of top surface of front cross member above normal top surface of side rail at #1 outer location: 6-21/32"

K - Height of top surface of side rail at front suspension cross member above normal top surface of side rail at #1 outer location: 6-63/64"

L - Height of top surface of rear suspension cross member at center line of rear wheels above normal top surface of side rail at #1 outer location; 13-1/2", Commercial Chassis 6-23/32"

M - Height of top surface of rear cross member above normal top surface of side rail at #1 outer location: 3-7/8"

Dimensions for X, Y, and Z are not given as they illustrate points for taking diagonal measurements for checking the squareness of the frame. Easily identifiable features of the frame are located at the approximate terminal points of the arrows and should be used in making these measurements.

ELDORADO FRAME GENERAL DESCRIPTION

A swept torque-box perimeter type frame, Fig. 2-4, is used on all 1972 model Cadillac Eldorados.

The frame is of fully boxed construction throughout its entire length. It encircles the passenger compartment with heavy side members, permitting a flat front floor with adequate seat height.

A full front crossmember and brackets support the front suspension. The rear portion of the frame is designed to utilize a four link coil suspension.

4. Body Mounts

Locations and cross sectional views of body mounts used on the 693 series are shown in Fig. 2-2.

The actual number of shims used may vary with each

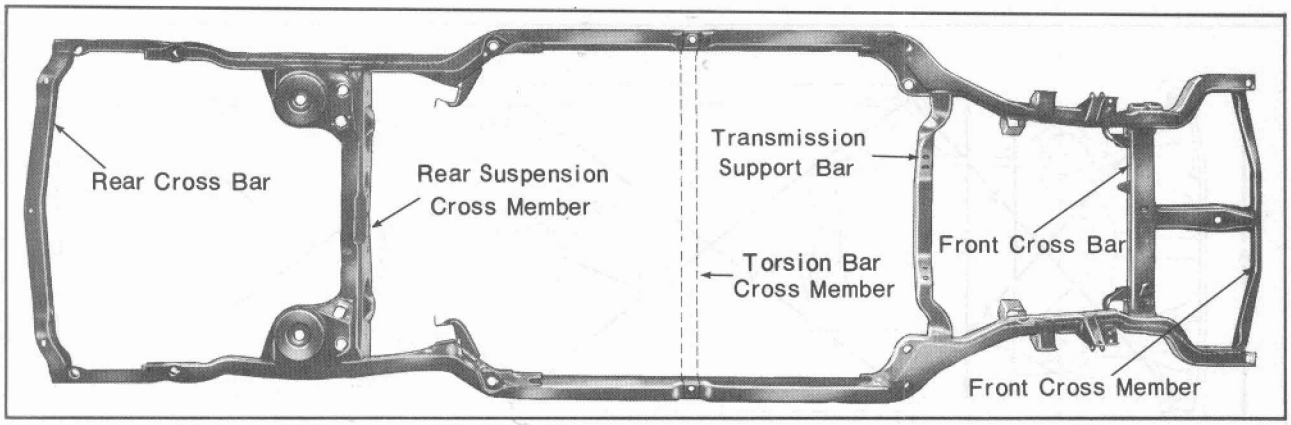


Fig. 2-4 Perimeter Frame - 693

installation. Use the quantity necessary to fill the gap remaining between the body and frame after the mounting pads are installed. The correct number of shims required at each mount location may be determined by attempting to rotate the pad between the body and the frame. If the pad can be rotated with the fingers, add body shims until pad can no longer be rotated.

5. Checking Frame For Twist

1. Place car on section of level floor, and inflate tires to proper pressure.
2. Measure distance from top of extreme front end of left side rail to floor. Repeat measurement for right side rail.
3. If front ends of right and left side rails are not the same distance from floor, raise low side rail with a jack until distances are equal.
4. Measure distance from extreme rear end of top of left rear side rail to floor. Repeat for right side rail.

6. Checking Frame Dimensions

Refer to frame checking locations, Fig. 2-5. The car should be on a flat, level floor to assure accurate measurements when either of the following methods are used.

The easiest and most accurate method of checking frame dimensions is by use of tram gages. When using tram gages, be sure to keep the gage cross bar level to insure accuracy in all measurements.

The "plumb bob" method may be used for measuring frame dimensions if tram gages are not available. Using this method, it is only necessary to have a piece of cord attached to an ordinary surveyor's plumb bob. When measuring the distance between two points, the free end of the cord should be placed at one of the points and a mark made on the floor exactly under the plumb bob. This operation should be repeated at the other point, and the distance between chalk marks on the floor may be easily measured.

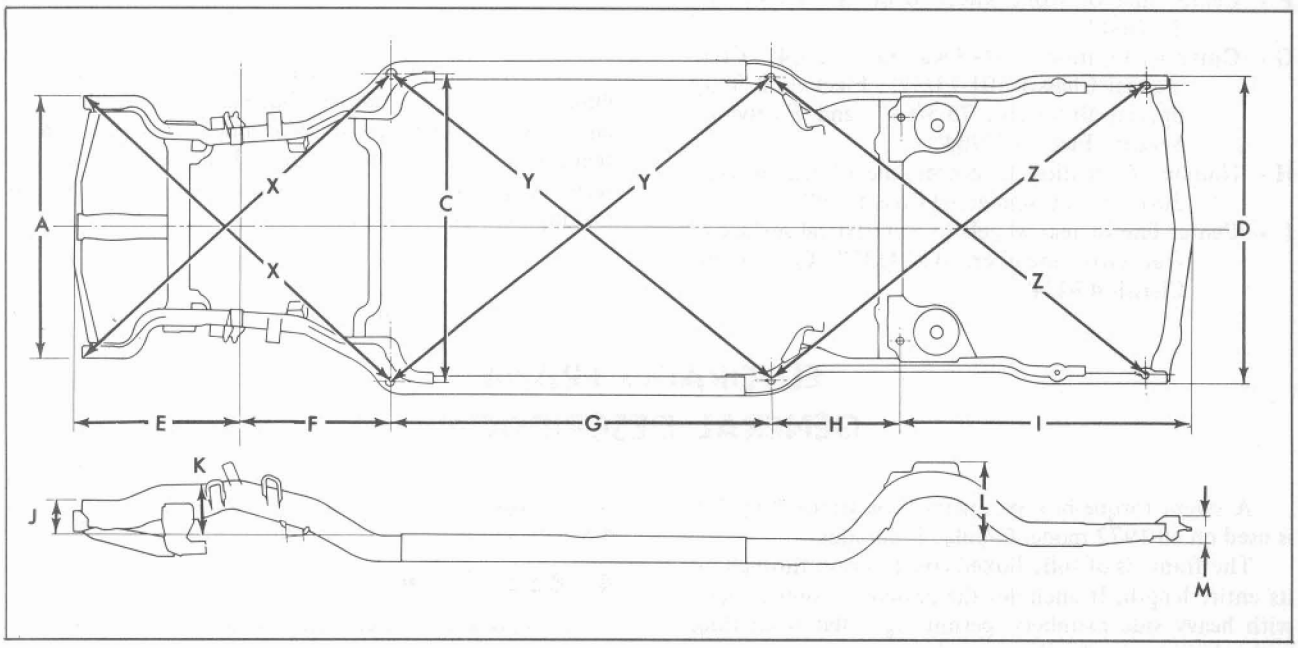


Fig. 2-5 Frame Checking Points - 693

(NOTE: The following frame checking dimensions apply to 693 series cars only.)

A - Width of frame at front - 46-27/32".
C - #2 left location to #2 right location - 55-1/8".
D - Width of frame at rear - 55".
E - Front vertical surface of front cross member to center line of front wheels - 29-7/8"
F - Center line of front wheels to #2 location - 27-1/32"
G - #2 location to #4 location - 68-19/32"
H - #4 location to #5 location - 23-3/8"
I - #5 location to rear surface rear cross member - 52-15/16"
J - Height of top surface of front cross member at center of frame above normal top surface of side rail at #2 location - 6-9/32"
K - Height of top surface of side rail at front suspension bar assembly front cross above normal top surface of side rail at #2 location - 9-1/8".
L - Height of top surface of rear suspension cross member at center line of rear wheel above normal top surface of side rail at #2 location - 13-15/32"
M - Height of top surface of rear cross member above normal top surface of side rail at #2 location - 3-31/32"

Dimensions for X, Y and Z are not given, as they illustrate points for taking diagonal measurements for checking the squareness of the frame. Easily identifiable features of the frame are located at the approximate terminal points of the arrows and should be used in making these measurements.

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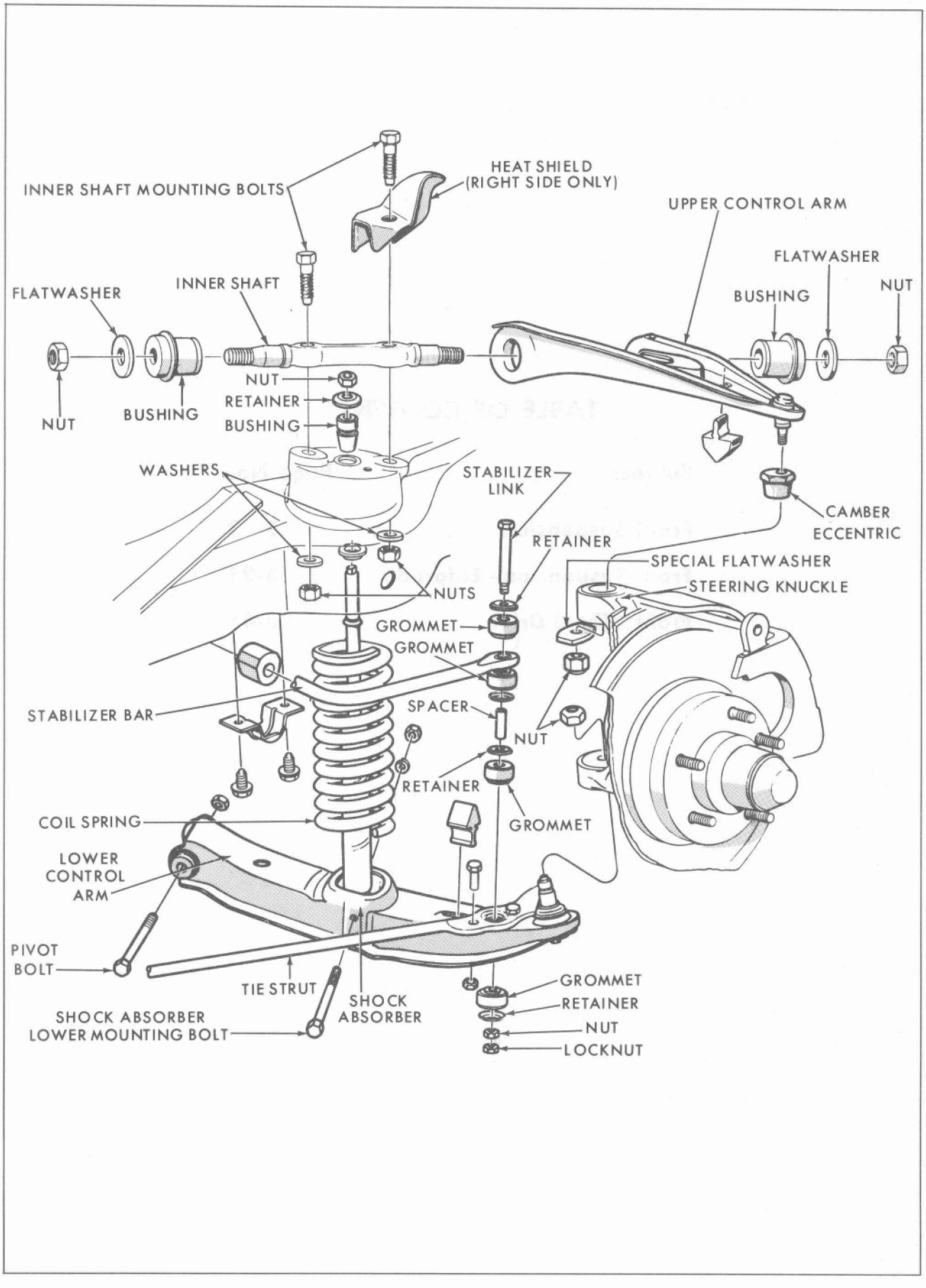


Fig. 3-1 Front Suspension Disassembled

FRONT SUSPENSION—EXCEPT ELDORADO

GENERAL DESCRIPTION

All 1972 Cadillac cars except the Eldorado use an independent spring type front suspension system, consisting of two upper and two lower control arm assemblies, steel coil springs, shock absorbers, front diagonal tie struts, a stabilizer bar, and two integral steering knuckles, Fig. 3-1. The system is designed so that the geometry of the upper and lower suspension arms produces an anti-dive reaction during braking.

The front suspension used on the Eldorado is described on Page 3-25.

Front Suspension System

a. Spherical Joints

Spherical joints are used at the outer ends of the upper and lower control arms. These joints are packed with lubricant and sealed at assembly, and should not require further lubrication throughout their service life under normal driving conditions. The only maintenance they normally require is an inspection of the seals for physical damage each time the engine oil is changed.

Steel service plugs are provided in the spherical joint covers so that the joints may be packed in the event a seal should become damaged and require replacement. Both the seals and plugs are serviceable.

The upper spherical joint is pressed into the upper suspension arm and tack-welded to the arm at two points. It connects the upper suspension arm to the steering knuckle through a camber adjustment eccentric. Camber adjustment is made by turning this eccentric to move the steering knuckle in or out at the top. The lower spherical joint, a tension type joint, is pressed into the lower suspension arm. It connects the lower suspension arm to the steering knuckle.

The spherical joints are designed to allow both the up-and-down movement of the wheel due to road irregularities, and the pivoting movement that takes place as the wheels are turned while steering.

b. Compression and Rebound Bumpers

A rubber compression bumper on the lower suspension arm limits upward travel of the suspension system and a rubber rebound bumper on the upper suspension arm limits downward travel. Both bumpers are held in place by means of a pull-through tab.

c. Tie-Struts

Diagonal tie-struts are used on the front suspension system to control the fore and aft movement of the wheels. The struts are bolted to the outer ends of the lower suspension arms just inboard of the spherical joints, and extend forward through the frame strut rod support member. At this point, the struts are threaded and secured by two locknuts. These locknuts also control caster adjustment. The attachment is cushioned by rubber bushings and steel retainers.

d. Suspension Arms

The upper suspension arms pivot at their inner ends on two flanged rubber bushings, one at each end of the one-piece suspension arm shaft, which is bolted to the top surface of the frame spring tower. The lower suspension arms pivot on a single rubber bushing that is bolted to the front suspension frame cross member.

The upper suspension arms and spherical joints are not interchangeable left and right. The lower suspension arms are not interchangeable, but their spherical joints are interchangeable.

e. Steering Knuckle

The integral steering knuckle is a combination steering knuckle, brake caliper support, and steering arm.

The steering knuckle is mounted to the tapered spherical joint studs at the outer ends of the upper and lower suspension arms. The splash shield is secured to the steering knuckle with three attaching screws.

The tie-struts and upper suspension arm shafts are interchangeable right and left, but the integral steering knuckles are not.

f. Stabilizer Bar

A front end stabilizer bar is used to provide steering stability and to control body roll. The stabilizer bar is mounted on the frame front side rails forward of the suspension arms and is connected to the lower suspension arms by steel links that are cushioned at each end in rubber bushings. The stabilizer bar extends across the car between its frame mounts.

g. Springs and Standard Shock Absorbers

The front wheels are controlled in their up-and-down movement by steel coil springs and direct, double acting, permanently sealed shock absorbers.

The springs are mounted with the lower ends seated on the lower suspension arms and the upper ends seated in towers on the front suspension frame cross member.

The standard shock absorbers incorporate a nylon skirted piston that provides a long-life bearing surface and uniform control of oil bleed around the piston. These shock absorbers provide efficient and constant damping control because oil is separated from air in the reservoir, which eliminates aeration of oil and prevents lag. Separation is accomplished by means of a pliacell envelope filled with an inert gas that takes the place of the air pocket.

The front shock absorbers are positioned in the center of the coil springs and are attached at the upper ends to the spring seat towers. The lower ends are attached to the lower suspension arms by bolts that go through the arms and the lower shock mount sleeves.

FRONT SUSPENSION DIAGNOSIS CHART

Condition	Cause	Correction
Car pulls to one side.	Uneven tire pressure.	Inflate tires to proper pressure.
	Front wheel alignment out of specification.	Check and adjust as necessary, Section 3, Note 2.
	Uneven standing height, left and right.	Perform procedure in Section 3, Note 1.
	Drag link height incorrect.	Perform procedure in Section 9, Note 5.
	Bent frame.	Check frame for proper alignment and repair as necessary.
	Brakes dragging.	See brake diagnosis, Page 5-7.
	Upper or lower suspension arm mounting bolts loose.	Check and correct all fastening torques.
	Wheel bearings adjusted too tight.	Check for binding with front wheels off floor. Adjust and lubricate bearings, Section 3, Note 17.
	Steering gear valve off center.	Replace valve assembly, Section 9, Note 12c.
Scuffed tires.	Toe-in incorrect.	Adjust as in Note 2d.
	Camber out of specification.	Adjust as in Note 2c.
	Tires improperly inflated.	Inflate to proper pressure.
Cupped tires.	Excessive wheel and/or tire runout.	Compensate as explained in Section 10, Note 4d.
	Wheels or tires out of balance.	Balance wheels and tires.
	Excessive on-center lash in steering gear.	Perform adjustments in Section 9, Note 4.
	Front shock absorber inoperative.	Replace shock absorber, Section 3, Note 3.
	Worn upper spherical joint.	Check joint as in Note 7a. Replace arm and joint assembly if necessary.
	Worn lower spherical joint.	Check joint as in Note 7b. Replace joint if necessary, following procedure in Note 11.
	Excessive (1/4" or more) vertical lash in idler arm frame pivot.	Replace idler arm assembly.
	Wheel bearings worn or incorrectly adjusted.	Adjust or replace bearings as necessary, Note 17.
Front wheel shimmy.	Wheels or tires out of balance.	Balance wheels and tires.
	Wheels or tires out of round.	Compensate for runout as described in Section 10, Note 4.
	Rough or cupped tire.	Isolate and replace.

FRONT SUSPENSION DIAGNOSIS CHART (Cont'd.)

Condition	Cause	Correction
Front wheel shimmy. (Cont'd.)	Steering gear or steering connections incorrectly adjusted or worn.	Check and adjust to specifications.
	Worn spherical joints.	Replace lower joints and/or upper arm assembly.
	Front wheel bearings incorrectly adjusted or worn.	Adjust or replace as required.
	Shock absorbers weak or inoperative.	Check and replace if necessary.
Car wanders.	Steering gear or connections adjusted too loosely or worn.	Adjust or install new parts as necessary.
	Drag link height incorrect.	Check and adjust to specifications.
	Worn spherical joints.	Replace lower joints and/or upper arm assembly.
	Toe-in or caster incorrectly adjusted.	Adjust toe-in and caster.
	Mixed tire brands.	Replace tires so that all are identical brand and type.
	Excessive friction in front suspension.	Check spherical joint seals for damage. If necessary, replace seals and repack joints.

SERVICE INFORMATION

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, suspension control arms, stabilizer bar, power steering pump hoses, and transmission cooler pipes.

When performing front end alignment or other operations that require loosening the camber eccentric in the knuckle by striking the bottom of the stud, exercise caution to prevent the striking tool from slipping and hitting the brake hose or the spherical joint seal.

When removing the camber eccentric or disconnecting the upper control arm ball stud, never use the brake hose to support or suspend the disc or caliper.

Never attempt to straighten a bent part; replace it with a new part.

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology *"See CAUTION on Page 3-5."*

CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

1. Checking Front Standing Spring Height

Before checking standing (spring) height, make sure that trunk is empty except for spare tire and jack and that there is a full tank of gasoline, as all specifications are based on this curb weight. Normalize position of springs by bouncing bumper up and down. Gradually reduce the force applied until the car seeks its own level.

a. Front Springs

Measure the distance from the top of the lower control arm in front of the rubber bumper to the flat surface of the bottom of the frame. Standing heights should be equal on both sides of car within 3/8 inch. If heights are unequal, it will be necessary to replace the spring on the low side.

See Fig. 3-2 for checking points and specifications for each series.

VEHICLE STANDING HEIGHTS			
STYLE		FRONT STANDING HEIGHT (INCHES)	REAR STANDING HEIGHT (INCHES)
68247	STANDARD	3-7/8 TO 4-5/8	6-1/8 TO 6-7/8
	WITH ALC	3-7/8 TO 4-5/8	4-7/8 TO 5-5/8
68249	STANDARD	3-7/8 TO 4-5/8	6-1/8 TO 6-7/8
	WITH ALC	3-7/8 TO 4-5/8	4-7/8 TO 5-5/8
68347	STANDARD	3-7/8 TO 4-5/8	6-1/8 TO 6-7/8
	WITH ALC	3-7/8 TO 4-5/8	4-7/8 TO 5-5/8
68349	STANDARD	3-7/8 TO 4-5/8	6-1/8 TO 6-7/8
	WITH ALC	3-7/8 TO 4-5/8	4-7/8 TO 5-5/8
68169	STANDARD	3-3/4 TO 4-1/2	4-7/8 TO 5-5/8
69723	STANDARD	4-7/16 TO 5-3/16	5-9/16 TO 6-5/16
69733	STANDARD	4-7/16 TO 5-3/16	5-9/16 TO 6-5/16
69347	STANDARD	8 TO 8-1/4	3.88 TO 4.64
69367	STANDARD	8 TO 8-1/4	3.88 TO 4.64

CHECKING POINTS

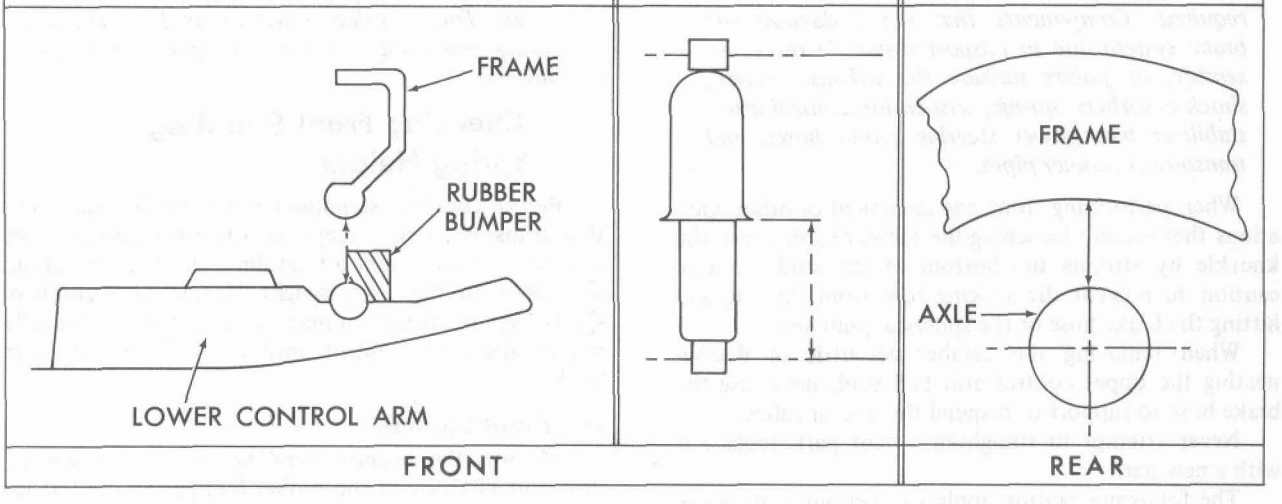


Fig. 3-2 Checking Standing Height

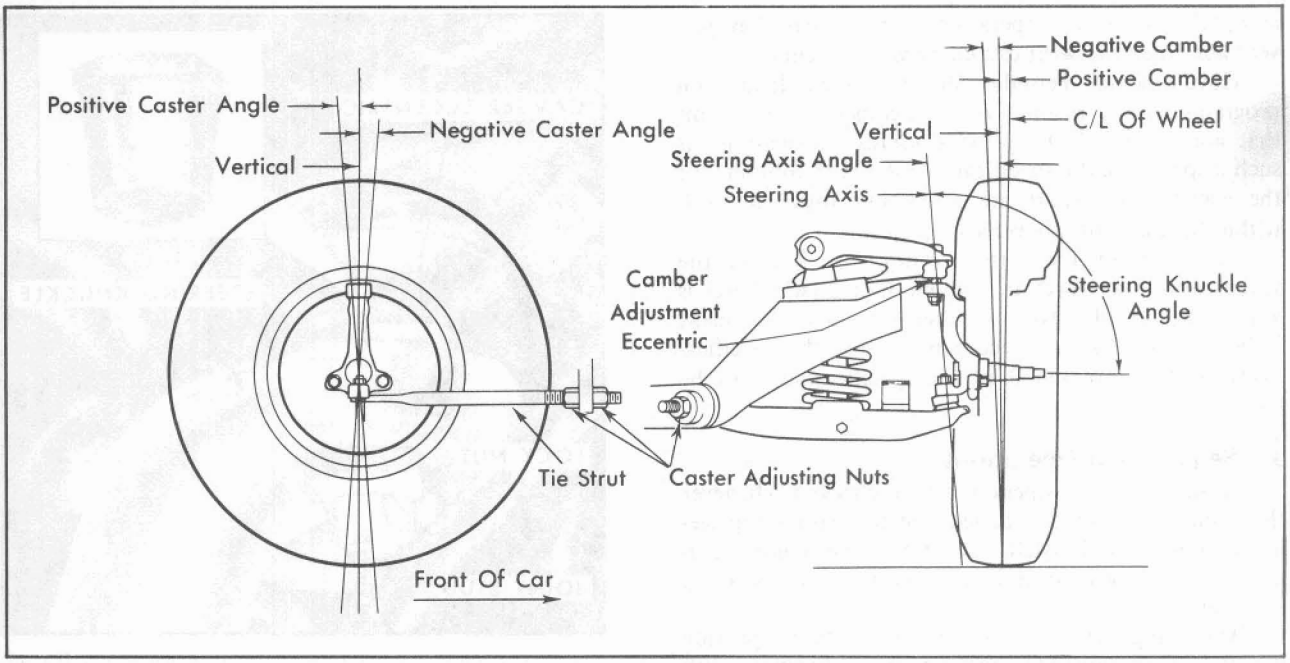


Fig. 3-3 Elements of Front Wheel Alignment

b. Ride Complaints

In case of hard riding the first items to investigate are tire pressures, standing heights, and shock absorbers. If these are correct, the amount of friction in the front suspension system should be checked.

The procedure for checking excessive friction in the front suspension is as follows:

1. Disconnect front shock absorbers.
2. With aid of a helper, lift up on the front bumper and raise the front end of the car as high as possible. Slowly release the bumper and allow the car to assume normal standing height. Measure distance from the floor to center of bumper. Then push down on bumper, release slowly, and allow car to assume normal standing height; again take measurement at same point on bumper.

If the difference between these two measurements is 1-1/4 inch or more, it indicates excessive friction in the suspension system. Probable causes include damaged seals on the spherical joints permitting dirt and water in the joints, bound up steering linkage, or excessive binding in the stabilizer bar mounting bushings.

2. Front Wheel Alignment (Fig. 3-3)

Satisfactory vehicle operation may occur over a wide range of front end (wheel) alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustment of alignment is advisable. The specifications stated in column 1 of the specifications chart should be used by owners, dealers, and repairmen as guidelines in vehicle diagnosis either for repairs under the new vehicle warranty or for maintenance service at customer's request. These specifications provide an

C–CAR WHEEL ALIGNMENT SPECIFICATIONS (AT CURB WEIGHT*)

	Specifications for Diagnosis for Warranty Repairs or Customer Paid Service	Specifications for Periodic Motor Vehicle Inspection	Specifications for Resetting Alignment
Camber	–3/4° to + 3/4°	–1-1/2° to + 1-1/2°	Left 0° ± 3/8° Right – 1/4° ± 3/8°
Cross Car Variation	1° Maximum	–	1/2° Maximum
Caster	–2° to 0°	–3° to + 1°	–1° ± 1/2°
Cross Car Variation	1° Maximum	–	1/2° Maximum
Toe-In	1/16" to 5/16"	3/16" Toe-Out to 9/16" Toe-In	3/16" ± 1/16"

*Curb weight means weight of vehicle including production options and full capacity of engine oil, fuel, and coolant.

acceptable all-around operating range in that they prevent abnormal tire wear caused by wheel alignment.

Governmental Periodic Motor Vehicle Inspection programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the specifications stated in column 2 of the specification chart are given and these are well within the range of safe vehicle operation.

In the event the actual settings are beyond the specifications set forth in column 1 or 2 (whichever is applicable), or whenever for other reasons the alignment is being reset, Cadillac recommends that the specifications given in column 3 of the specification chart be used.

a. Sequence of Operations

Front wheel alignment must be checked whenever the standing height is changed due to a spring replacement, removal and installation of an upper control arm assembly, a lower control arm, tie-strut, or a steering knuckle.

Wheel alignment equipment manufacturers provide detailed instructions for checking wheel alignment with their alignment equipment. These instructions should be carefully followed.

In addition to the manufacturer's instructions, be sure to observe the following recommendations:

1. Car must be on a level surface, gas tank full or a compensating weight added as shown in Fig. 3-38, front seat all the way to the rear, and front and rear tires inflated to the proper pressures. Refer to Tire Pressure Chart, Fig. 10-1, Section 10. Both doors must be closed and no passengers or additional weight should be in car or trunk.
2. Check front standing height. Refer to Note 1.
3. Check straight ahead position of steering wheel by driving vehicle a short distance. Place a piece of tape on steering wheel at straight ahead position of wheel for future reference, so that any correction needed can be made during the toe-in adjustment.
4. Check front wheel alignment and adjust as required.
5. After removing the vehicle from the alignment machine, check the straight ahead position of the steering wheel to determine if it is properly centered. If further correction is required, repeat the toe-in portion of the wheel alignment procedure so that the necessary changes can be made.

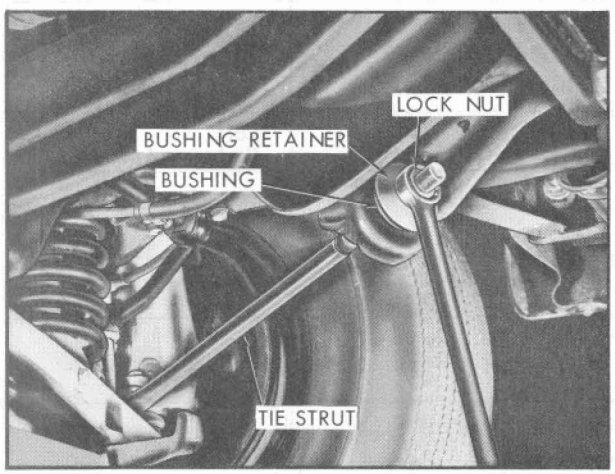


Fig. 3-4 Adjusting Caster

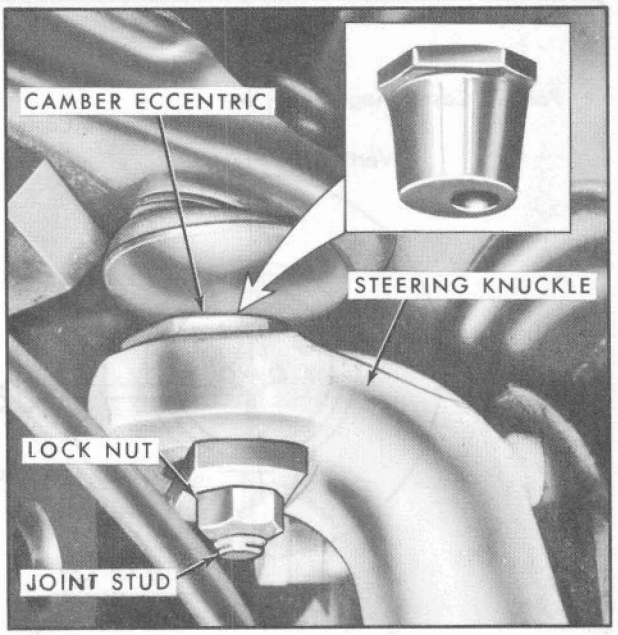


Fig. 3-5 Camber Adjusting Eccentric

b. Caster

Caster adjustment is obtained by shortening or lengthening the tie-struts between the lower suspension arms and frame strut rod support member to tilt the vertical steering axis of the knuckle. Tilting toward the front of the vehicle results in negative caster - toward the rear, positive caster.

Before adjusting caster, loosen tie-struts at lower suspension arms. This will allow tie-strut to center itself and prevent damage to bushings and premature wear at frame strut rod support member.

To provide more negative caster, lengthen tie-struts by loosening front locknuts and tightening rear locknuts. One turn of locknuts results in approximately 1/2° change in caster.

To provide more positive caster, shorten tie-struts by loosening rear locknuts and tightening front locknuts.

After proper caster adjustment has been made, tighten tie-strut mounting bolt nuts at lower arms to 55 foot-pounds, and front locknuts to 35 foot-pounds, Fig. 3-4. *(See CAUTION on Page 3-5.)* Recheck to make sure adjustment is correct after locknuts have been tightened.

c. Camber

Camber is adjusted at the camber eccentric located in the upper portion of the steering knuckle, Fig. 3-5. The upper spherical joint stud fits through the camber eccentric and the knuckle. Turning camber eccentric moves the steering knuckle in or out at the top.

To adjust camber, loosen locknut on spherical joint stud one turn and strike steering knuckle in area of spherical joint stud to free camber eccentric in steering knuckle, Fig. 3-6.



Fig. 3-6 Loosening Camber Eccentric

CAUTION: Use extreme care to prevent the striking tool from slipping and hitting either the brake hose or the spherical joint seal.

Using Camber Adjustment Wrench, J-23415, Fig. 3-7, turn camber eccentric until desired camber is obtained.

Final position of joint stud should be in rear portion of camber eccentric in order to keep steering arm angle correct. Tighten locknut on spherical joint stud to 60 foot-pounds. *(See CAUTION on Page 3-5.)*

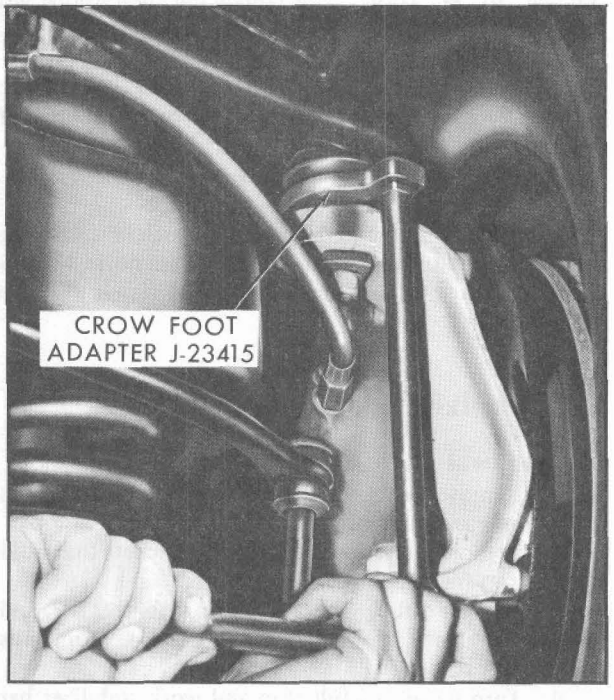


Fig. 3-7 Adjusting Camber

d. Toe-In

Before checking toe-in, make certain that drag link height is correct. See Section 9, Note 5, for drag link height.

The readings should be taken only when the front wheels are in a straight ahead position so that the steering gear is on its high spot.

Toe-in is adjusted by turning the tie rod adjuster tubes at outer ends of each tie rod after loosening clamp bolts.

CAUTION: Do not use a pipe wrench or heavy tool to free tie rod adjuster tubes if they are seized, rusted, or corroded. If necessary, use penetrating oil or pry tie rod adjuster tubes open with a flat bladed tool. Replace tie rod adjuster tubes, or tie rod outer pivots if damaged. If torque required to remove nut from bolt exceeds 7 foot-pounds, discard nut and bolt.

The tie rod adjuster tubes should be lubricated with chassis lubricant if disassembled from tie rods for any reason. When turning adjuster tubes, be careful not to turn tie rod ends so that they bottom out, as seals could become pinched between stud and socket and become damaged. If this happens, the entire pivot must be replaced.

Be sure to turn both adjuster tubes an equal amount when adjusting toe-in so that relation of steering gear high spot to straight ahead position of front wheels will not be changed.

When adjustment has been completed according to recommended specifications, tighten nuts on clamp bolts to 22 foot-pounds.

Both the tie rod ends and joint studs should be in a centralized position before tightening clamps. Check relationship between jaws of clamp and slot in adjuster tube. Do not allow corner of one to catch on a corner of the other, Fig. 3-8.

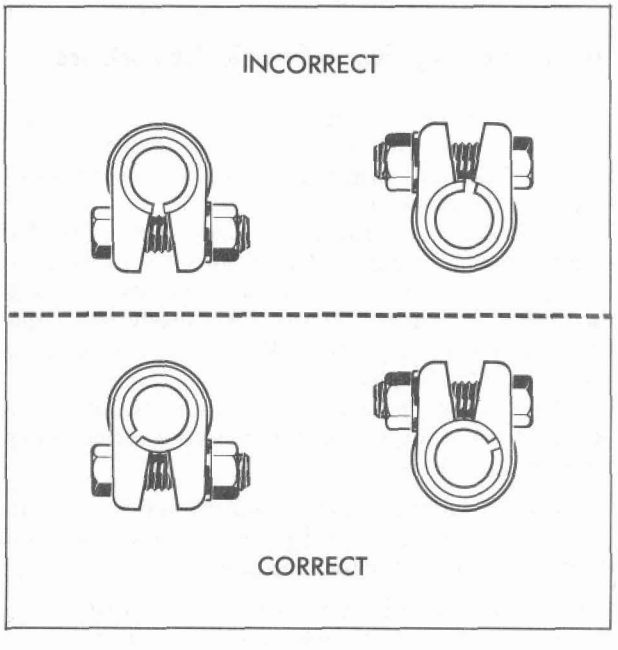


Fig. 3-8 Tie Rod Clamp Position

Each tie rod should be checked after adjustment by grasping the center of the tie rod and moving it up and down. The movement should be equal in both directions; if not, it is an indication that the pivot studs are not properly positioned. If tie rods are not properly positioned, a binding condition may occur, resulting in poor return of wheels to straight ahead position. Also check steering linkage joints for looseness. Replace inner or outer tie rod pivot if loose.

3. Front Shock Absorbers

a. Removal

1. Raise hood and remove shock absorber upper retaining nut and retainer at frame spring tower. The shock absorber upper stem is square at the top so that it may be held by a wrench to prevent stem from turning when removing nut.
2. Remove bolt, nut, and lockwasher holding lower end of shock absorber to lower suspension arm.
3. Remove shock absorber through bottom of lower arm.

b. Installation

1. If new grommet is required, dip grommet in a soapy water solution and force grommet through frame hole with a twisting motion.

CAUTION: Do not use silicone lubricant.

2. Install retainer on shock absorber upper stem, and fully extend shock absorber rod.
3. Insert shock absorber assembly up into coil spring and guide stem through grommet. Then place lower end in position on lower suspension arm, and install bolt, lockwasher, and nut. Tighten bolt to 55 foot-pounds.
4. Install retainer and nut on shock absorber upper stem, and tighten nut to 15 foot-pounds, while holding stem from turning with wrench.

4. Checking Front Shock Absorbers

1. Check all tire pressures.
2. Check shock absorber mounting torques.
3. If possible, road test car to determine the exact nature of the problem.
4. Quickly alternate pushing down and lifting left front corner of bumper. Repeat process for right front corner. The feeling of resistance should be equal between right and left. If so, it is unlikely that either shock requires replacement. If noticeable variation is felt, proceed to Step 6.
5. Visually inspect shock absorbers. If oil is detected, check for leaks in power steering system, transmission cooler lines, etc.

(NOTE: A slight trace of shock fluid is not cause for replacement as the seal permits some seepage from fluid reserve for piston rod lubrication.)

6. Raise car and remove one shock absorber.
7. Clamp shock absorber upside down in vise.

(NOTE: Cadillac shock absorbers can be turned upside down because all internal vapor (inert gas instead of air) is contained in a pliacell envelope which prevents aeration of oil and prevents lag.)

8. Pump shock by hand at various rates of speed and observe resistance. Resistance should be smooth and constant.

(NOTE: Rebound resistance is approximately twice as strong as that of compression.)

9. Compare resistance felt with that of a unit known to be good. The following conditions are abnormal and require replacement of shock absorber:

a. A skip or lag at reversal near mid-stroke.
b. A seize (except at either extreme of travel)
c. A grunt or squeal after completion of one full stroke in each direction.
d. A clicking noise at fast reversal.
e. Fluid leakage.

A skip at full extension with shock absorber inverted, or a faint hiss ("orifice swish") are normal conditions and do not indicate necessity of shock absorber replacement.

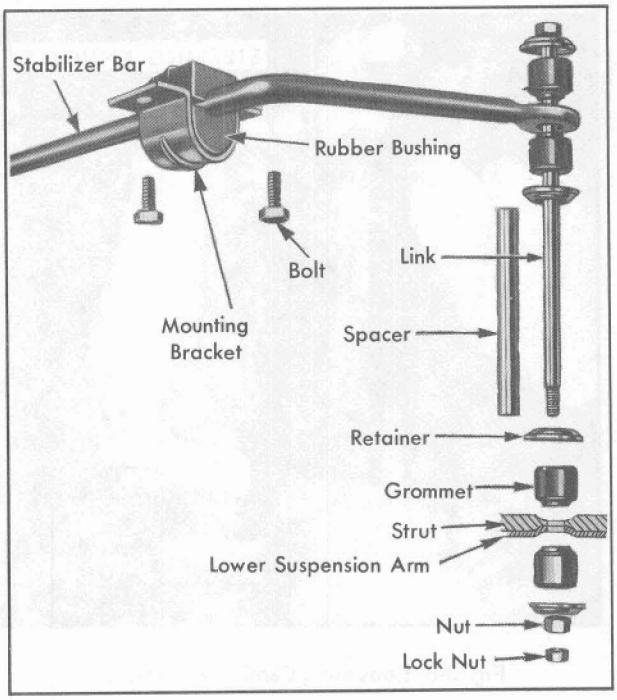


Fig. 3-9 Front Stabilizer Linkage

5. Stabilizer Bar

a. Removal

1. Remove nuts, retainer, and grommet from bottom of each stabilizer link, Fig. 3-9.
2. Remove bolts from mounting brackets that hold stabilizer to frame and remove brackets.
3. Remove rubber bushings from stabilizer bar, and remove grommets, retainers, spacers, and links from ends of stabilizer bar.
4. Turn wheels to full stop and work stabilizer bar from car.

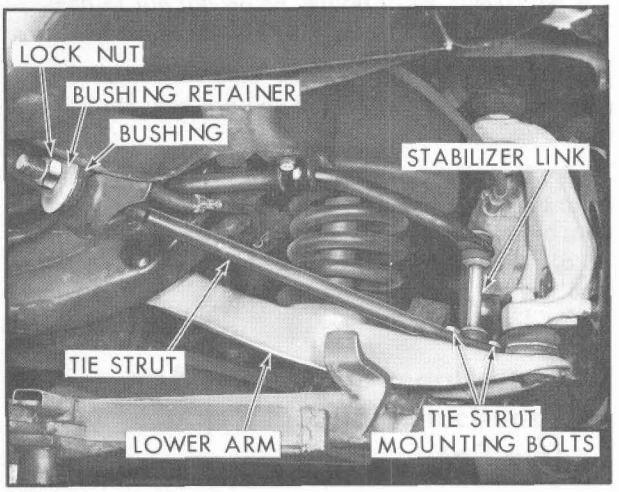


Fig. 3-10 Front Suspension Tie Strut

b. Installation

1. Position stabilizer bar under front frame side rails and slide rubber bushings in place.
2. Install mounting brackets over rubber bushings and secure with bolts, Fig. 3-9. Tighten bolts to 35 foot-pounds.
3. Install grommets, retainers, links, and spacers on ends of stabilizer bar, making certain that retainers and grommets are arranged exactly as shown in Fig. 3-9.
4. Install grommet, retainer, nut, and locknut on bottom of each link. Tighten nuts to end of threads.

6. Tie-Strut and Bushings

a. Removal

1. Raise car.
2. Disconnect stabilizer link from lower arm on side from which tie-strut is to be removed.
3. Remove locknut, bushing retainer, and bushing from forward end of tie-strut, Fig. 3-10.

(NOTE: If replacing only bushings, do not disturb rear locknut on tie-strut, otherwise it will be necessary to readjust caster and camber.)

4. Remove two bolts and nuts securing tie-strut to lower suspension arm and remove strut.
5. Remove tie strut from car.
6. Remove rear bushing, spacer, and retainer from tie-strut.
7. Remove rear locknut from tie-strut if necessary.

b. Installation

1. If rear locknut was previously removed, install a new locknut (3/4 inch thick) on threaded end of tie-strut, and run nut approximately 3/4 inch from end of thread.
2. Install rear bushing retainer on tie-strut with concave side against nut.
3. Insert metal spacer part way through conical shaped bushing from small end, and install on tie-strut with small end toward front of car.
4. With tie-strut held in a horizontal position, install threaded end through frame strut rod support member.
5. Position opposite end of tie-strut on lower suspension arm with pointed end pointing inward, and install two attaching bolts and nuts loosely.
6. Install front bushing on end of tie-strut, concave side toward frame, and slide bushing against strut rod support member.
7. Install front bushing retainer on tie-strut with concave side against bushing, Fig. 3-10.
8. Start new locknut (5/8 inch thick) on threaded end of tie-strut.
9. Connect stabilizer link to lower suspension arm. Make certain that grommets, retainers, nuts, and locknuts are installed properly.
10. Lower car and, with car weight on all four wheels, position front bushing on metal spacer and tighten locknut on front end of tie-strut to 35 foot-pounds. *(See CAUTION on Page 3-5.)*
11. Tighten tie-strut to lower arm attaching nuts to 55 foot-pounds. *(See CAUTION on Page 3-5.)*
12. If rear locknut was disturbed during tie-strut removal or installation, adjust caster and camber as described in Notes 2b and 2c.

7. Front Suspension Spherical Joint Checking Procedures

a. Upper Spherical Joints

1. Raise car, place jack stands under lower control arm, and remove wheel and tire assembly. Scribe or punch an alignment mark between steering knuckle and camber eccentric to facilitate reinstallation.
2. Back off upper spherical joint stud locknut approximately two turns. Do not remove locknut. This will prevent hub and rotor from collapsing outward when joint stud is broken free from knuckle.
3. Using a hammer, strike steering knuckle in area of upper spherical joint stud to separate joint and knuckle, Fig. 3-6, then remove locknut and flat washer from stud.

CAUTION: Use extreme care to prevent hammer from slipping and hitting either the brake hose or spherical joint seal.

(NOTE: On some cars, camber eccentric may come out with stud. This is a normal condition.)

4. Lift upper arm to remove spherical joint stud from knuckle.
5. Using regular spherical joint stud nut and a second nut as a locknut, turn joint in its socket with an inch-pound torque wrench. Reading should fall between 24 and 48 inch-pounds. If joint is too tight or too loose, replace joint and upper arm as an assembly.
6. Remove both nuts from stud.
7. Install joint stud in knuckle and install special flat washer and an ordinary nut on stud. Tighten nut to seat joint stud in knuckle.

(NOTE: If camber eccentric separated from knuckle in Step 3, use alignment marks for proper orientation.)

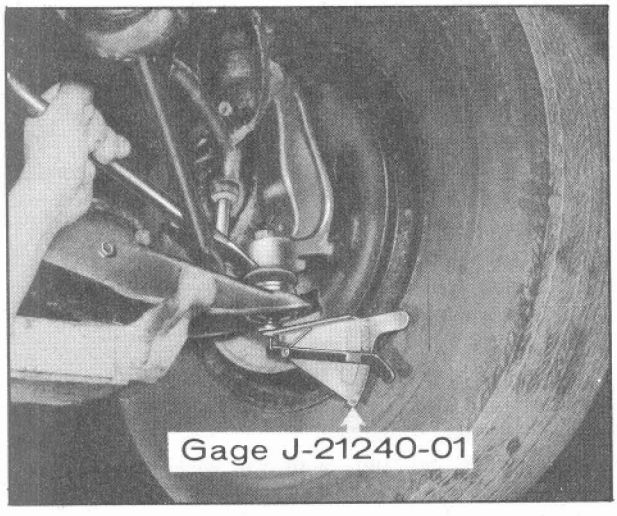


Fig. 3-11 Checking Lower Spherical Joint End Play-on Hoist

8. Remove nut and install locknut, tightening to 60 foot-pounds. *(See CAUTION on Page 3-5.)*

9. Install wheel and tire assembly, tightening wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*

10. Check camber and caster and adjust if necessary, as described in Notes 2b and 2c.

b. Lower Spherical Joints

1. Raise front of car so that vehicle weight is on front suspension and tires are free to rotate.

2. Clean all road deposits from spherical joint lower cover and unscrew service plug.

3. Install Spherical Joint Checking Gage, J-21240-01, in spherical joint lower cover, tightening captive nut finger-tight.

4. Note position of movable arm on scale, then use a pry bar or long screwdriver to pry between lower control arm and bottom of steering knuckle, Fig. 3-11. Note position of movable arm during load condition. Pry and release several times to check for consistent reading.

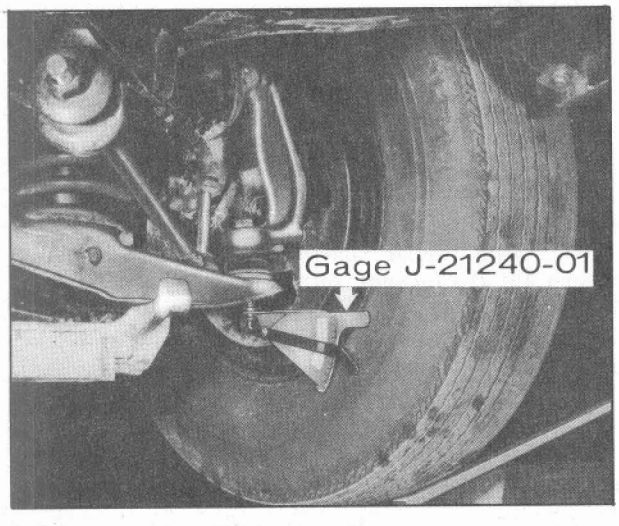


Fig. 3-12 Checking Lower Spherical Joint End Play-on Jack Stands

CAUTION: When prying, be careful not to damage spherical joint seal.

(NOTE: If jack stands are used for support, use a pry bar and a block of wood and pry between tire and floor, Fig. 3-12.)

5. Note the change in reading on scale. If change is more than .062", replace spherical joint. (Small graduations on scale equal .010" gage probe travel.)

6. Remove Checking Gage, J-21240-01, and install service screw in lower cover.

7. Lower car.

8. Front Upper Suspension Arm Spherical Joint Seal Replacement (On Car)

1. Raise front end of car and place jack stands under lower suspension arms.

2. Remove wheel and tire assembly.

3. Loosen upper spherical joint locknut.

4. Scribe a mark on camber eccentric and steering knuckle to facilitate alignment at time of installation.

5. Using a hammer, strike steering knuckle in area of upper spherical joint stud until joint is free from steering knuckle, then remove nut and special flat washer from stud, Fig. 3-6.

CAUTION: Use extreme care to prevent hammer from slipping and hitting the brake hose.

6. Raise up on upper arm and remove spherical joint from steering knuckle.

7. Remove camber eccentric from joint stud, using Puller, J-8990, Fig. 3-13.

(NOTE: In cases where camber eccentric is seized or "frozen" to joint stud, remove upper suspension arm assembly, and remove camber eccentric as a bench operation.)

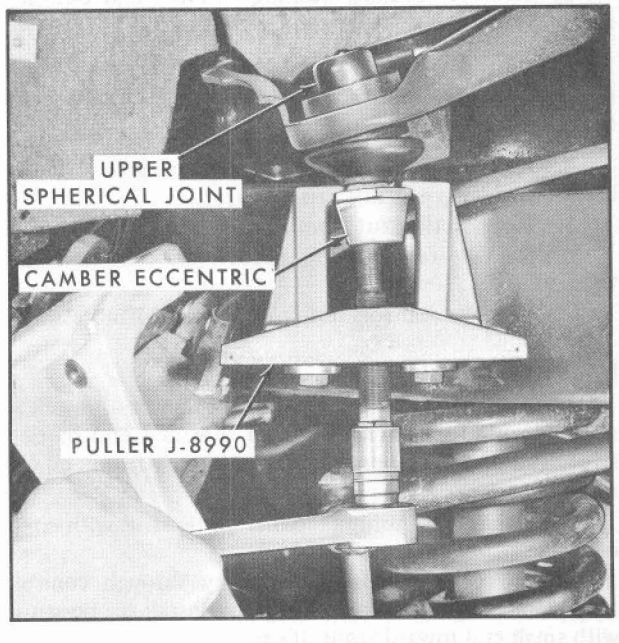


Fig. 3-13 Removing Camber Eccentric

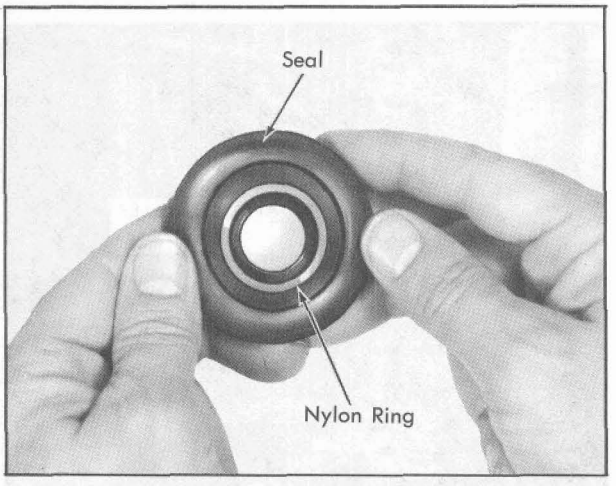


Fig. 3-14 Installing Nylon Ring on Seal

8. Wipe outer seal surface clean to prevent any dirt from lodging in joint pivot when seal is removed.

9. Pry garter spring from seal. Remove and discard seal and spring.

10. Clean joint pivot and stud thoroughly, removing all old grease and any dirt accumulation.

11. Inspect ball pivot for loosening or binding, Note 7. Joint should turn in its socket at 24 to 48 inch-pounds. If spherical joint is damaged or worn, replace joint and arm as an assembly.

12. Unscrew service plug from spherical joint cover.

13. Install new seal on spherical joint. Proceed as follows:

a. Compress seal on flat surface to pucker small hole of seal.

b. Place nylon ring over center of puckered hole, Fig. 3-14.

c. Press in on underside of seal, and press nylon ring until nylon ring seats itself in groove around hole. Continue to press seal until it assumes normal shape.

d. Apply a small amount of lubricant, Part No. 1050411 or equivalent, around hole in seal. Wipe groove in joint housing clean and install seal on joint stud. Make certain the large groove diameter of seal engages in recess (circular groove) around joint housing.

e. Allow air to enter seal by momentarily prying large lip of seal away from joint housing with a small screwdriver.

f. Grasp small end of seal and extend toward threaded end of stud.

g. Install new garter spring on the smaller flanged surface of Garter Spring Installer, J-9148, and lubricate inside diameter of installer with suspension lubricant.

h. Install spring on seal using Garter Spring Installer, J-9148, Fig. 3-15. Make certain that spring secures lip of seal in recess all around joint housing.

(NOTE: If spring should separate where it is joined together, it is not an indication that the spring is broken. Join spring ends together and lock by twisting male end counterclockwise approximately 2-3 turns. Ends will thread into each other upon releasing.)

14. Using Repacking Gun, J-9280, and Adapter, J-9280-5, apply lubricant, Part No. 1050411 or equivalent, until approximately two teaspoons of lubricant escapes under the seal at the screwdriver, Fig. 3-16. Any water trapped in the joint should be forced out by the fresh lubricant.

CAUTION: Make certain that proper type lubricant is used when repacking suspension joints as use of any other lubricant may contribute to premature failure.

15. Install service plug in spherical joint cover, tightening to 4 foot-pounds.

16. Apply a light coating of grease on outside taper of camber eccentric and install camber eccentric on joint stud.

17. Thoroughly clean inside of steering knuckle and install joint stud and camber eccentric in steering knuckle, remembering to align scribe marks on eccentric and knuckle.

18. Install special flat washer and standard 1/2"-20

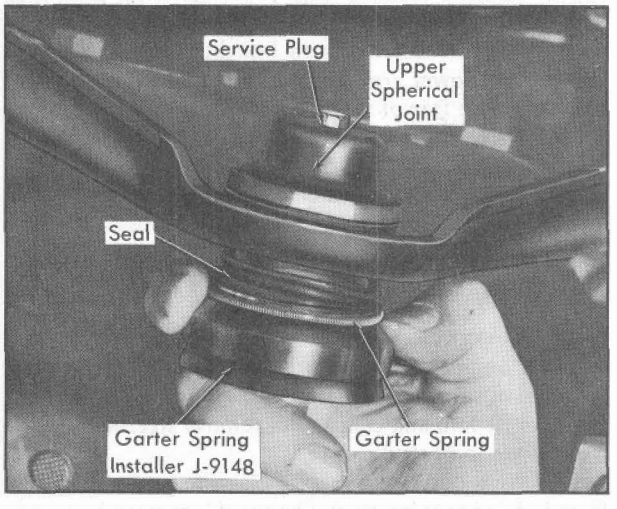


Fig. 3-15 Installing Garter Spring on Upper Spherical Joint Seal

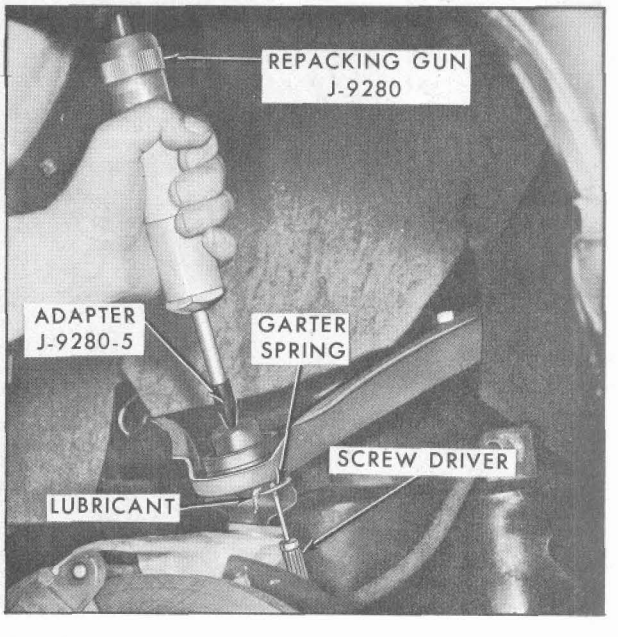


Fig. 3-16 Repacking Front Upper Spherical Joint Seal

nut on joint stud and tighten nut until camber eccentric locks in knuckle; then remove standard nut, holding flat washer in place, and install locknut, tightening to 60 foot-pounds. *(See CAUTION on Page 3-5.)*

19. Install wheel and tire assembly, remove jack stands, and lower car.

20. Check camber and caster and adjust if necessary, following Notes 2b and 2c.

9. Repacking Front Lower Suspension Arm Spherical Joint Seal

1. Raise car.

2. Clean off all road deposits from affected lower spherical joint seal and unscrew steel plug at bottom of joint housing.

3. Using Repacking Gun, J-9280, and Adapter, J-9280-5, apply lubricant, Part No. 1050411 or equivalent, until grease is forced out between upper end of seal and knuckle, Fig. 3-17. Any water trapped in the joint should be forced out by the fresh lubricant.

(NOTE: After removing repacking gun, allow some lubricant to escape through fitting to relieve seal pressure before installing plug.)

4. Install service plug, tightening to 4 foot-pounds.

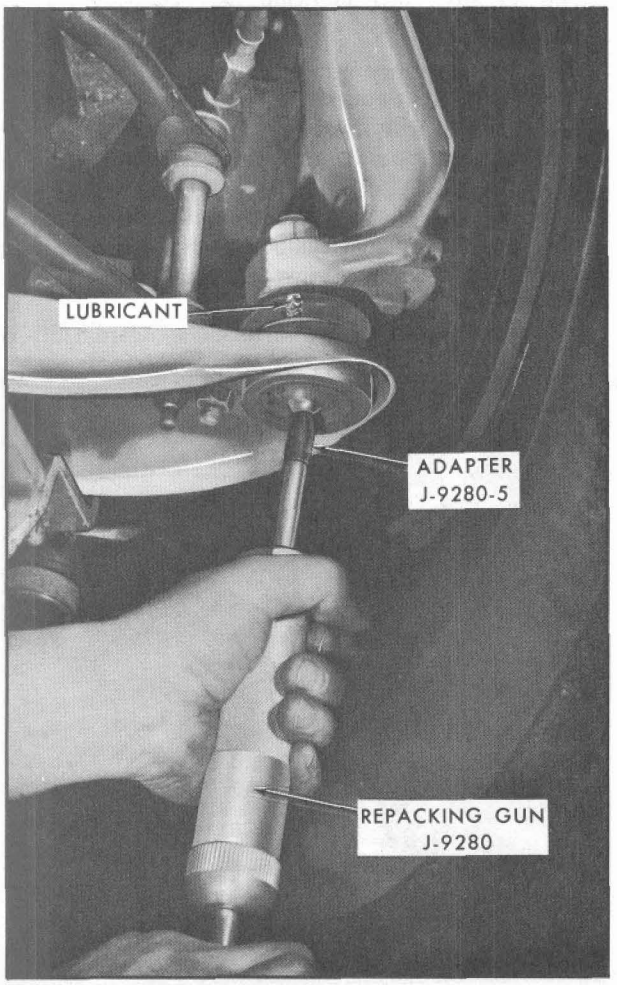


Fig. 3-17 Repacking Front Lower Spherical Joint Seal

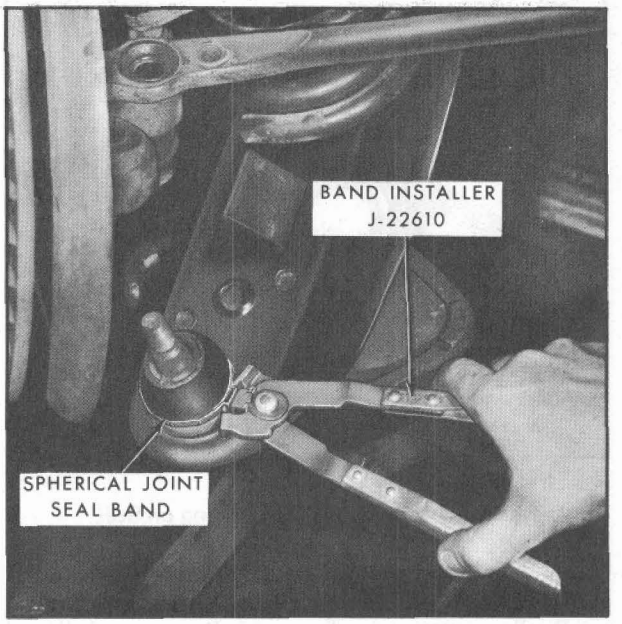


Fig. 3-18 Installing Spherical Joint Seal Band

5. Inspect seal for cuts, chafes, or pin holes. Escape of lubricant from any place other than top of seal indicates a damaged seal that should be replaced.

6. Repeat steps 2 through 5 on opposite side of car.

7. Lower car.

10. Front Lower Suspension Arm Spherical Joint Seal Replacement (On Car)

1. Raise car and place jack stands under lower suspension arms approximately 2 inches inboard of spherical joints.

CAUTION: Jack stands must be used to prevent lower arm from swinging down when locknut is removed from joint stud.

2. Remove wheel and tire assembly.

3. Remove locknut from lower spherical joint stud and install a standard nut on joint stud, running nut to within two threads of steering knuckle support. This nut will prevent lower arm from dropping down when joint stud is broken free of steering knuckle.

4. Raise front of car slightly off jack stands with hydraulic jack.

5. Strike steering knuckle with a heavy hammer in area of spherical joint stud to break stud loose.

CAUTION: Use extreme care to prevent hammer from slipping and hitting the brake hose.

6. Lower car on jack stands, being certain that rebound bumper on upper arm clears frame, and remove standard nut from joint stud.

7. Lift hub and caliper and remove steering knuckle from lower joint stud.

8. Wipe outer seal surface clean to prevent any dirt from lodging in joint pivot when seal is removed.

9. Pry copper band off bottom of seal. Remove and discard seal and band.

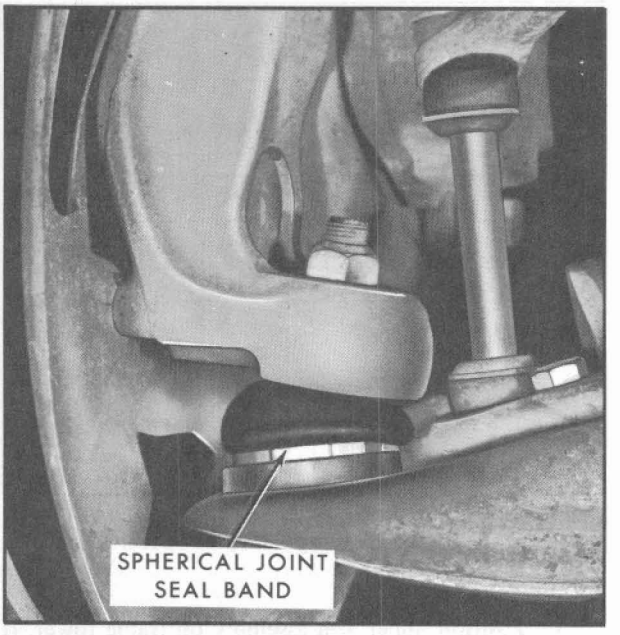


Fig. 3-19 Spherical Joint Seal Band Position

10. Clean joint pivot and stud thoroughly, removing all old grease and any dirt accumulation.

11. Unscrew service plug from spherical joint.

12. Inspect ball pivot for looseness or binding, Note 7. Free play should not exceed .062" as the joint operates vertically in its socket. Replace joint if it exceeds this limit.

13. Install a new seal on spherical joint using Seal Band Installer, J-22610, Fig. 3-18, to position band on seal as shown in Fig. 3-19.

CAUTION: Spherical joint housing at point of seal contact must be completely dirt and grease free to insure a good seal when band is installed.

14. Using Repacking Gun, J-9280, and Adapter, J-9280-5, Fig. 3-17, apply lubricant, Part No. 1050411 or equivalent, until approximately two teaspoons of lubricant escapes from the joint.

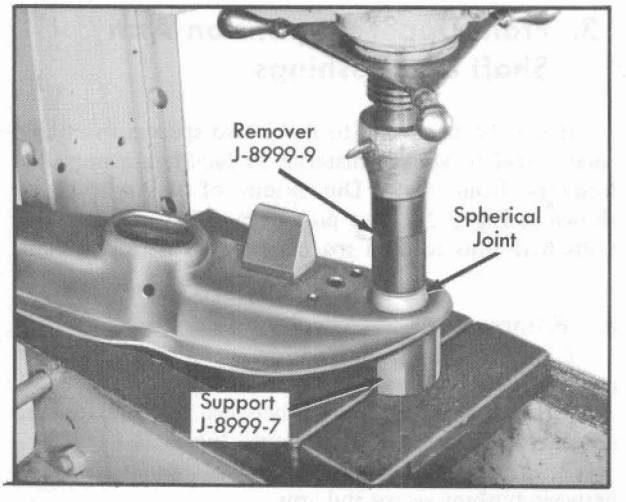


Fig. 3-20 Removing Spherical Joint from Lower Arm

15. Install service plug, tightening to 4 foot-pounds.

16. Guide spherical joint stud into steering knuckle support.

17. Install standard nut and an ordinary flat washer on joint stud and tighten nut until joint stud seats in steering knuckle support.

18. Remove standard nut and washer and install locknut on joint stud, tightening to 85 foot-pounds. *(See CAUTION on Page 3-5.)*

(NOTE: A large quantity of grease will purge from upper end of joint because seal volume is reduced when installed in steering knuckle. Remove excess grease.)

19. Install wheel and tire assembly, tightening wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*

20. Replace wheel disc, remove jack stands, and lower car.

11. Front Lower Suspension Arm Spherical Joint

a. Removal

1. Remove lower suspension arm and coil spring as described in Note 14a.

2. Remove band and seal from spherical joint.

3. Using an arbor press, position Support, J-8999-7, on press anvil and place lower arm on Support with spherical joint cover resting in Support.

4. Position Spherical Joint Remover, J-8999-9, over joint stud until it seats on joint housing, Fig. 3-20, and press spherical joint out of arm.

b. Installation

1. Using an arbor press, position Support, J-8999-7, on press anvil and place lower arm on support, bottom side up, so that spherical joint mounting hole is encompassed by support.

2. Insert new spherical joint in arm, stud end first, aligning joint housing with mounting hole.

3. Position Spherical Joint Installer, J-8999-5, on flanged portion of joint housing, Fig. 3-21, and press

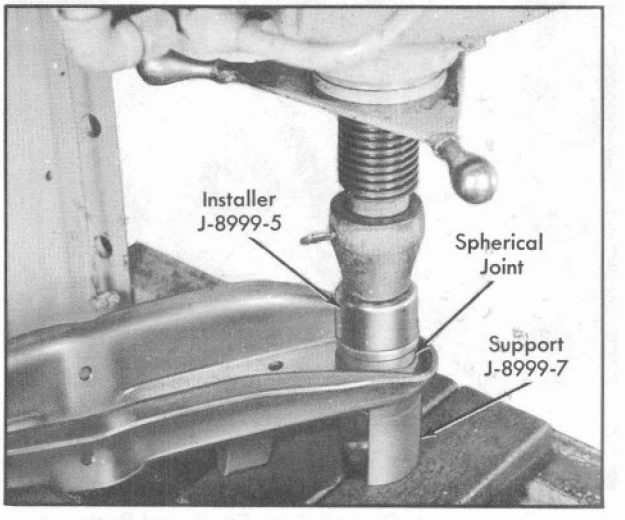


Fig. 3-21 Installing Spherical Joint in Lower Arm

spherical joint into arm until joint flange bottoms on mounting hole flange.

4. Install lower suspension arm and coil spring as described in Note 14b.

12. Front Upper Suspension Arm

a. Removal

1. Raise front of car, place jack stands under lower suspension arms, and remove wheel and tire assembly.

2. Remove locknut and flat washer from upper spherical joint stud and install a standard nut on end of joint stud.

3. Using a hammer, strike steering knuckle in area of upper spherical joint stud until joint is free from steering knuckle, then remove nut from stud, Fig. 3-6.

CAUTION: Use extreme care to prevent hammer from slipping and hitting either the brake hose or the spherical joint seal.

4. Remove nuts, washers, and shaft mounting bolts at frame tower, Fig. 3-22. Remove upper suspension arm and shaft assembly. If right upper control arm is being removed, remove rear bushing heat shield.

5. Remove nut and flat washer from each end of shaft.

6. Camber eccentric may be removed from spherical joint stud if necessary, by using Puller, J-8990.

CAUTION: Do not attempt to remove spherical joint from upper suspension arm. Since it is welded to arm, any rewelding could damage joint seal or weaken arm. The upper arm and spherical joint are serviced as an assembly.

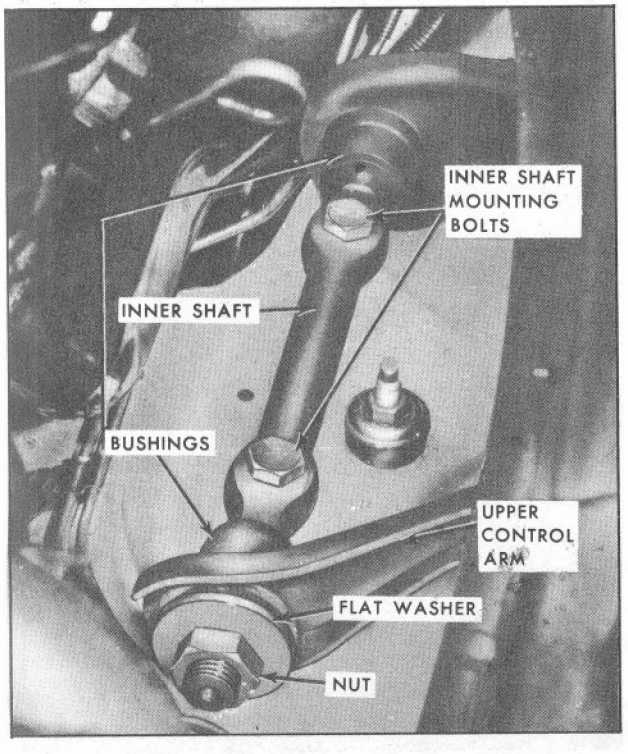


Fig. 3-22 Upper Control Arm, Shaft, and Bushings Installed

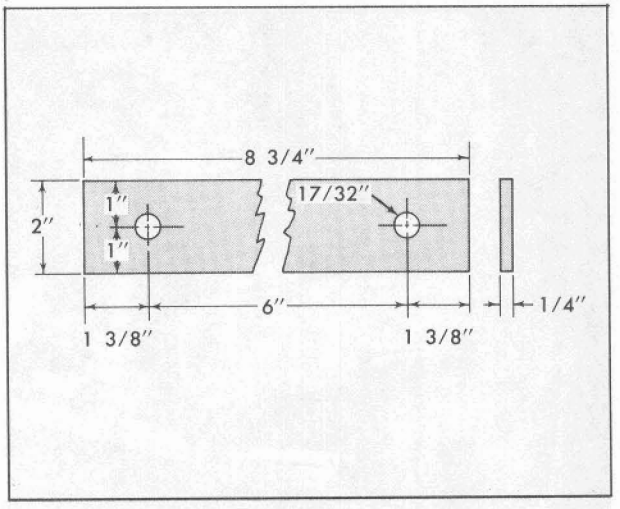


Fig. 3-23 Bushing Remover Spacer

b. Installation

1. Position upper arm assembly on frame tower. If right upper control arm is being installed, position heat shield over rear bushing and install mounting bolts, washers, and locknuts, Fig. 3-22. Tighten bolts to 85 foot-pounds. *(See CAUTION on Page 3-5.)*

2. Install camber eccentric on joint stud if previously removed.

3. Guide joint stud and camber eccentric into upper end of knuckle and install standard nut and special flat washer on end of joint stud.

4. Tighten nut until camber eccentric seats in knuckle; then remove standard nut and, holding flat washer in place, install locknut. Tighten to 60 foot-pounds. *(See CAUTION on Page 3-5.)*

5. Install wheel, remove jack stands, and lower car. Then tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*

6. Install flat washer and shaft attaching nut on each end of shaft. Tighten nuts to 75 foot-pounds. *(See CAUTION on Page 3-5.)*

7. Check wheel alignment and adjust if necessary.

13. Front Upper Suspension Arm Shaft and Bushings

It will be necessary to make two spacers from cold rolled steel or similar material to facilitate removal of bushings from shaft. Dimensions of the spacers are shown in Fig. 3-23. Also provide two 1/2 inch x 2 inch bolts with nuts to hold spacers in position around shaft.

a. Removal

1. Remove upper suspension arm assembly, following procedure of Note 12a.

2. Install spacers on shaft between arm ends. Secure spacers to shaft with bolts and nuts, Fig. 3-24.

3. Apply a liberal amount of penetrating oil between bushing sleeve and arm.

4. Position Support, J-8999-2, on anvil of arbor

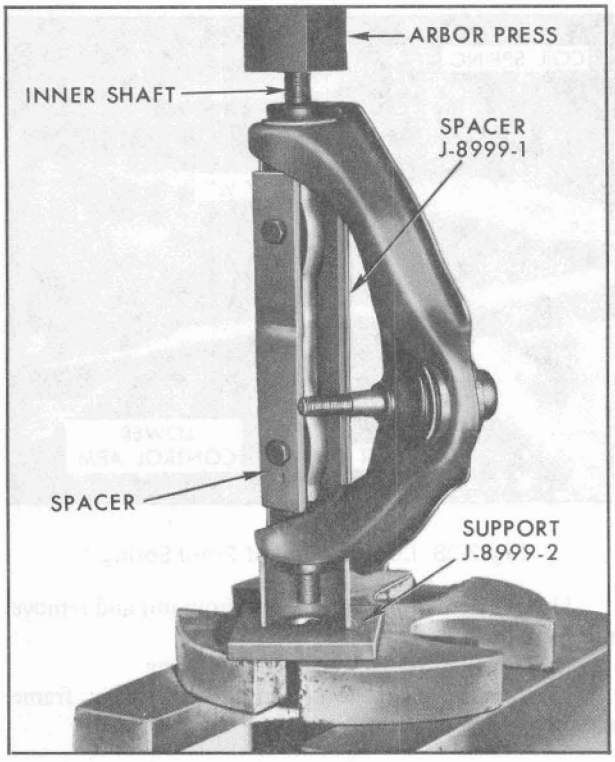


Fig. 3-24 Removing Bushing from Upper Arm

press and place one end of arm on support with outer end of bushing resting in support.

(NOTE: It will be necessary to drill a 1-1/4" hole in

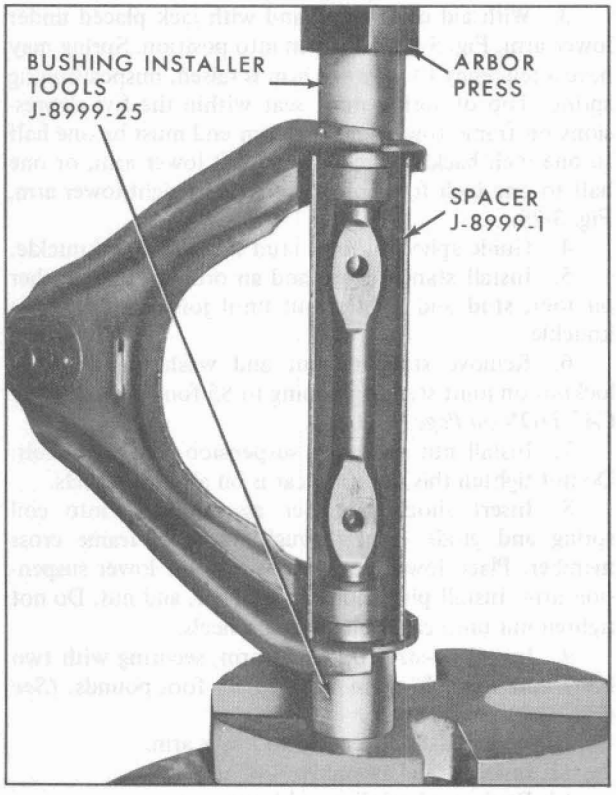


Fig. 3-25 Installing Shaft and Bushing in Upper Arm

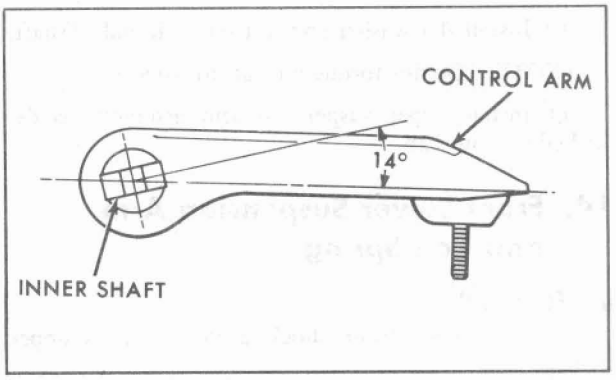


Fig. 3-26 Alignment of Upper Control Arm and Inner Shaft

center of base of Support, J-8999-2, so that shaft does not bottom before bushing is removed. Position anvil of press so that slot in anvil aligns with hole in Support, J-8999-2.)

5. Insert Spacer, J-8999-1, to prevent control arm from bending when bushings are pressed out.

6. Drive shaft downward until spacer plates touch extruded flanges of control arm, Fig. 3-24.

7. Remove arm assembly from arbor press, insert on opposite end, and repeat step 6.

8. Remove arm assembly from arbor press. If necessary, tap end of bushing with hammer to complete its removal.

9. Remove Spacer, J-8999-1, from assembly. Remove spacer bolts, nuts, and plates from shaft, and remove shaft.

b. Installation

1. Position one Bushing Installer, J-8999-25, on arbor press anvil.

2. Insert inner shaft in control arm and place bushing over end of shaft and into hole in control arm.

3. Place arm and bushing on bushing installer with outer end of bushing seated in installer, Fig. 3-25.

4. Rotate inner shaft until a 14° angle is achieved between shaft and control arm as shown in Fig. 3-26.

(NOTE: This angle is important in that it prevents bushing strain after installation and lengthens bushing life.)

5. Position bushing on opposite end of shaft, and place the other Bushing Installer, J-8999-25, on top of bushing. Hold assembly in place by exerting slight pressure on arbor press, Fig. 3-25.

6. Check alignment of bushings, arm ends, and shaft.

7. Install Spacer, J-8999-1, around shaft between arm ends to prevent arms from collapsing when bushings are installed.

8. Using arbor press, press bushings onto shaft until both bushing flanges bottom on arms.

(NOTE: It is possible that both bushing inner sleeves may not butt flush against shaft shoulder. However, when shaft attaching nuts are tightened, bushing inner sleeves will seat themselves.)

9. Remove arm assembly and installer tools from arbor press, and remove spacer tool.

10. Install flat washer and nut on each end of shaft.

(NOTE: Do not torque nuts at this time.)

11. Install upper suspension arm assembly as described in Note 12b.

14. Front Lower Suspension Arm and Coil Spring

a. Removal

1. Disconnect front shock absorber at its upper mount.
2. Raise front of car and place jack stands under front frame side rails.
3. Remove wheel assembly.
4. Disconnect stabilizer link from lower arm that is to be removed.
5. Disconnect tie-strut at lower arm.
6. Remove bolt, nut, and washer securing shock absorber to lower arm and remove shock absorber from lower mount.
7. Remove nut from pivot bolt in lower arm at frame mount.
8. Position hydraulic jack under outboard end of lower suspension arm so that jack is supporting arm.
9. Remove locknut from lower spherical joint stud. Install standard nut on joint stud and run nut to within two threads of knuckle.

(NOTE: Nut will prevent lower arm from dropping when joint stud is broken free of steering knuckle.)

10. Strike knuckle with a hammer in area of spherical joint stud to break joint loose. To facilitate removal of joint stud from knuckle, raise opposite rear corner of car to help compress spring.

CAUTION: Use extreme care to prevent hammer from slipping and hitting the brake hose.

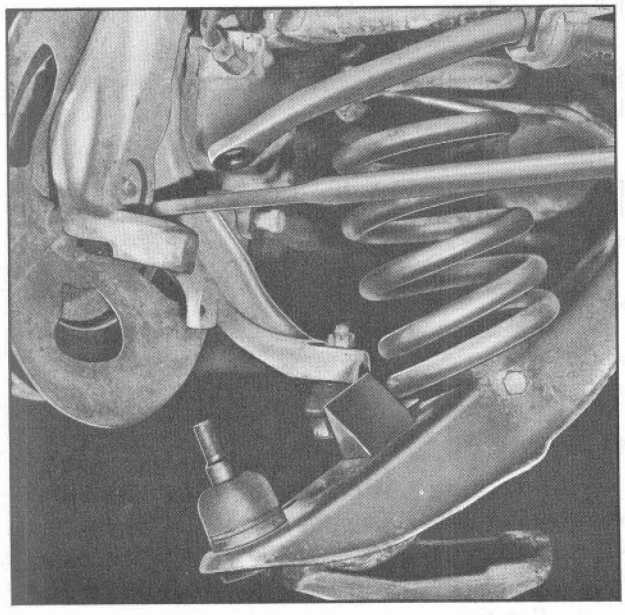


Fig. 3-27 Coil Spring Installation

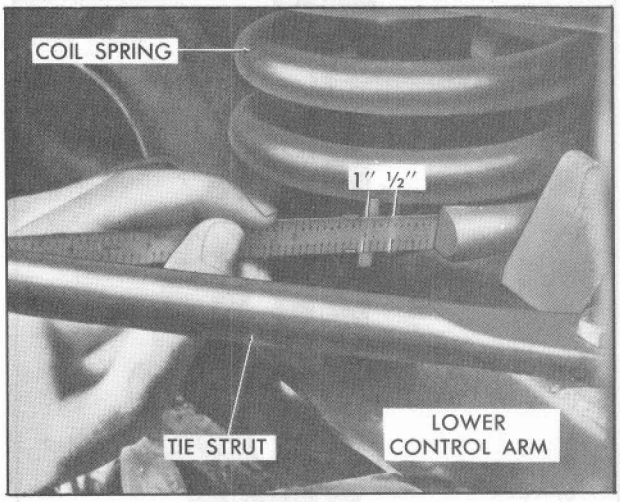


Fig. 3-28 Locating End of Front Spring

11. Use jack to lift spring load from nut and remove nut from joint stud.
12. Slowly lower jack and remove spring.
13. Remove pivot bolt from lower arm at frame mount and remove arm.

b. Installation

1. Position inboard end of lower arm in frame mount and install pivot bolt. Do not install nut at this time.

(NOTE: Raised edge on top of arm faces front of car on right side and rear of car on left side.)

2. Install end of spring in upper seat of frame.
3. With aid of a helper and with jack placed under lower arm, Fig. 3-27, raise arm into position. Spring may have a tendency to rotate as arm is raised, mispositioning spring. Top of spring must seat within the five depressions on frame tower, and bottom end must be one half to one inch back of the front of left lower arm, or one half to one inch forward of the back of right lower arm, Fig. 3-28.
4. Guide spherical joint stud into steering knuckle.
5. Install standard nut and an ordinary flat washer on joint stud and tighten nut until joint stud seats in knuckle.
6. Remove standard nut and washer and install locknut on joint stud, tightening to 85 foot-pounds. *(See CAUTION on Page 3-5.)*
7. Install nut on lower suspension arm pivot bolt. Do not tighten this nut until car is on all four wheels.
8. Insert shock absorber assembly up into coil spring and guide stem through tower in frame cross member. Place lower end in position on lower suspension arm. Install pivot bolt, lockwasher, and nut. Do not tighten nut until car is on all four wheels.
9. Install tie-strut on lower arm, securing with two bolts and nuts. Tighten nuts to 55 foot-pounds. *(See CAUTION on Page 3-5.)*
10. Connect stabilizer link to lower arm.
11. Install wheel assembly.
12. Replace wheel disc and lower car.
13. Connect shock absorber at its upper mount.

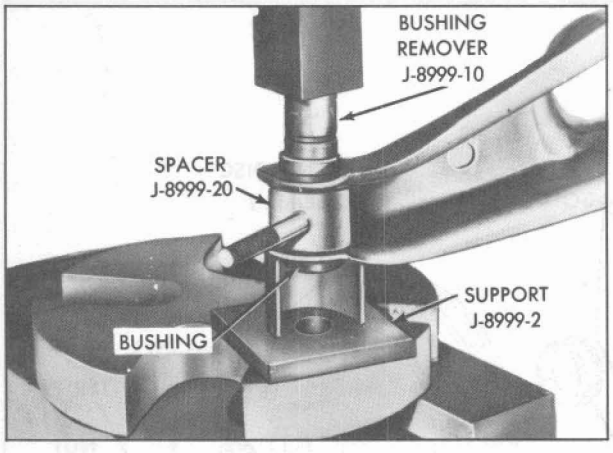


Fig. 3-29 Removing Bushing from Lower Arm

14. Tighten nut on lower suspension arm pivot bolt to 95 foot-pounds. *(See CAUTION on Page 3-5.)*

15. Tighten nut at shock absorber lower mount in lower arm to 55 foot-pounds. *(See CAUTION on Page 3-5.)*

15. Front Lower Suspension Arm Bushing

a. Removal

1. Remove lower suspension arm and coil spring as described in Note 14a.

2. Use a stiff wire brush to clean the small outer diameter end of the bushing and the portion of the bushing between the legs of the arm.

(NOTE: This step will help prevent corrosion on the bushing outer sleeve from gouging grooves in the arm upon removal.)

3. Position Support, J-8999-2, on arbor press anvil and insert larger diameter end of bushing in Support.

4. To prevent lower arm from collapsing when bushing is pressed out, place Spacer, J-8999-20, around inner flange of lower control arm. Inner flange is located on larger diameter bushing side.

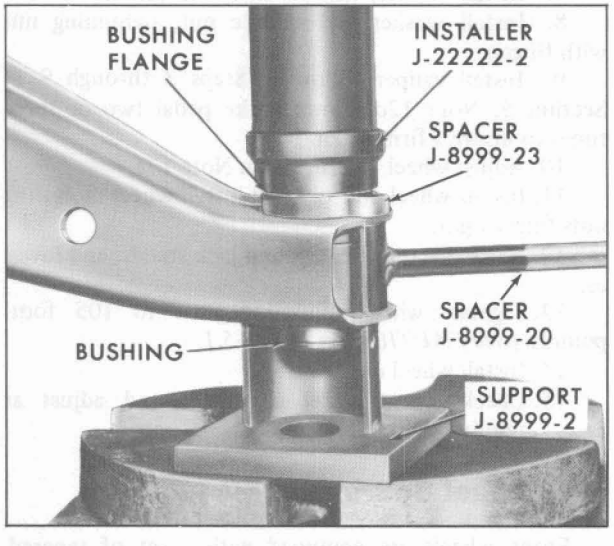


Fig. 3-30 Installing Bushing in Lower Arm

5. Position Bushing Remover, J-8999-10, on sleeve, Fig. 3-29, and press bushing out of arm.

6. Inspect bushing holes in front lower control arm for distortion or gouges in holes. If arm is damaged, it will be necessary to replace arm.

b. Installation

1. Position Support, J-8999-2, on arbor press anvil and insert smaller diameter flanged end of bushing mount in Support.

2. Install new bushing in arm, smaller diameter end of bushing first, until bushing pilots itself in opposite flanged end.

3. Place Spacer, J-8999-20, around inner flange of lower control arm and insert Spacer, J-8999-23, between bushing flange and control arm, Fig. 3-30.

4. Position Bushing Installer, J-22222-2, over end of bushing and press bushing into arm until bushing flange bottoms on Spacer, J-8999-23.

5. Remove arm assembly and all tools from press.

6. Install lower suspension arm and coil spring as described in Note 14b.

16. Steering Knuckle

a. Removal

1. Remove wheel disc and loosen wheel mounting nuts on side from which steering knuckle is to be removed.

2. Raise front end of car and place jack stands under front frame side rails.

3. Remove wheel mounting nuts and remove wheel and tire.

4. Remove two bolts securing brake caliper to steering knuckle. Slide caliper off disc and use a piece of wire to attach caliper to upper control arm.

CAUTION: Never allow caliper to hang from brake hose.

5. Remove dust cap, cotter pin, spindle nut, and washer.

6. Remove outer cone and bearing assembly.

7. Remove hub and disc assembly from steering knuckle spindle, Fig. 3-31.

8. Remove three screws securing splash shield to steering knuckle, and remove splash shield and seal.

9. Place a jack under lower suspension arm on side from which steering knuckle is to be removed.

10. Remove cotter pin and nut from tie-rod end stud.

11. Using Puller, J-8990, remove tie-rod joint from steering knuckle, Fig. 3-32.

12. Remove locknut from lower joint stud. Using a hammer, strike knuckle in area of joint stud to break joint loose.

CAUTION: Use extreme care to prevent hammer from slipping and hitting the brake hose.

13. Remove locknut from upper spherical joint stud and, leaving special flat washer in place, install standard nut on joint stud and run nut to within two threads of knuckle.

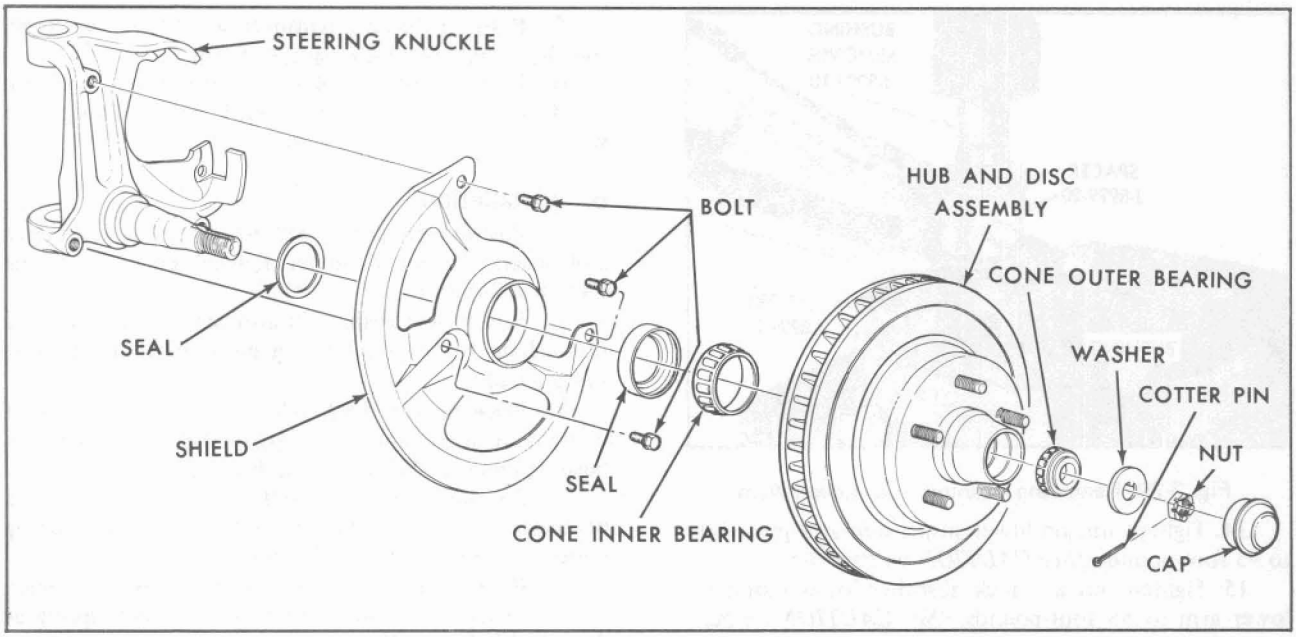


Fig. 3-31 Front Wheel Disassembled

14. Using a hammer, strike knuckle in area of joint stud to break joint loose.

CAUTION: Use extreme care to prevent hammer from slipping and hitting the brake hose.

15. Remove standard nut and flat washer, raise up on upper arm, and remove joint stud from end of steering knuckle.

16. Lift steering knuckle off lower joint stud and remove knuckle from car.

b. Installation

1. Guide upper joint stud into steering knuckle upper support and install a standard nut and special flat washer on joint stud. Tighten nut to seat joint stud in knuckle.

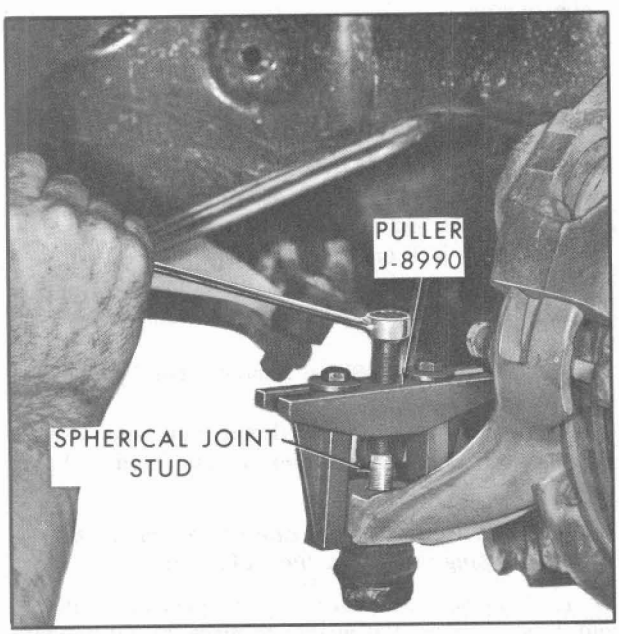


Fig. 3-32 Removing Tie Rod Joint Stud from Steering Knuckle

2. Remove standard nut and, holding flat washer in place, install locknut, tightening to 60 foot-pounds. *(See CAUTION on Page 3-5.)*

3. Guide lower spherical joint stud into steering knuckle lower support.

4. Install standard nut and an ordinary flat washer on joint stud and tighten until stud seats in knuckle, then remove standard nut and washer and install locknut, tightening to 85 foot-pounds. *(See CAUTION on Page 3-5.)*

5. Install tie-rod end on steering knuckle and install nut. Tighten nut to 37 foot-pounds and install cotter pin. *(See CAUTION on Page 3-5.)*

6. Position seal and splash shield on steering knuckle. Install three screws securing splash shield to steering knuckle and tighten screws to 10 foot-pounds.

7. Install hub and disc assembly on spindle.

8. Install washer and spindle nut, tightening nut with fingers.

9. Install caliper following Steps 3 through 9 of Section 5, Note 12c. Pump brake pedal two or three times to insure a firm pedal.

10. Adjust wheel bearings as in Note 17a.

11. Install wheel and tire and install wheel mounting nuts finger tight.

12. Raise car, remove jack and jack stands, and lower car.

13. Tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*

14. Install wheel disc.

15. Check front wheel alignment and adjust as required, Note 2.

17. Wheel Bearings

Front wheels are equipped with a set of tapered roller bearings mounted in opposing directions to

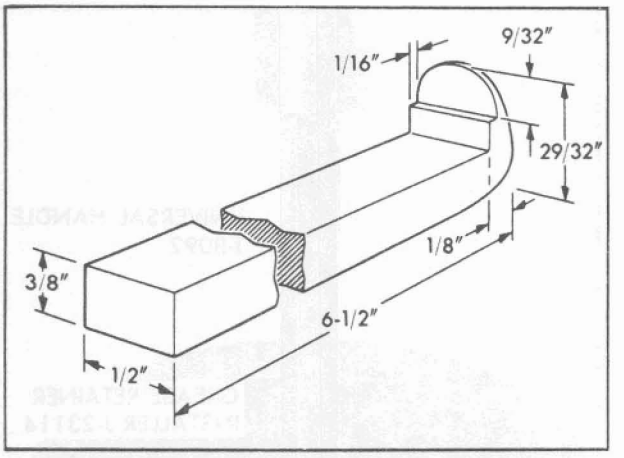


Fig. 3-33 Grease Retainer Remover Tool

accommodate various combinations of vehicle loading, Fig. 3-31.

a. Front Wheel Bearing Adjustment

1. Raise front of car. Remove wheel disc, dust cap, and cotter pin. Make sure hub is fully seated on spindle.
2. While rotating wheel and tire assembly, tighten spindle nut to 15 foot-pounds to seat all bearing parts.
3. Back off spindle nut until free (approximately one flat) then retighten until nut is finger tight.
4. Install new cotter pin. If pin cannot be installed at finger tight position, back off nut until holes line up and install pin.

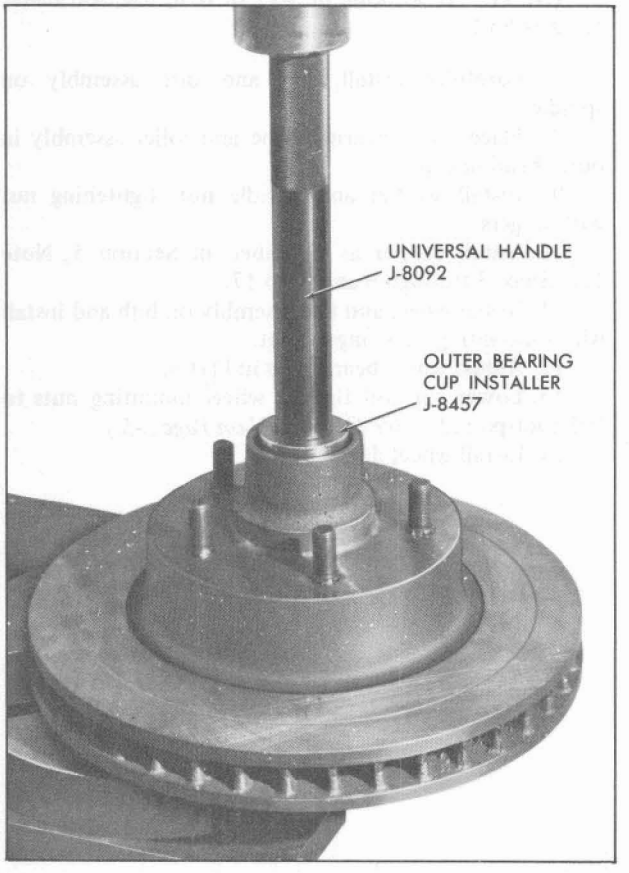


Fig. 3-34 Installing Outer Bearing Cup

5. Spread cotter pin and bend back around sides of nut. Install dust cap and make sure ends of cotter pin do not interfere with dust cap.

CAUTION: Cotter pin must be tight after installation. If pin can be moved with finger, remove pin and install another new cotter pin.

6. Install wheel disc and lower car.

b. Front Wheel Bearing Removal

1. Remove wheel disc.
2. Loosen wheel mounting nuts.
3. Raise front end of car.
4. Remove wheel mounting nuts and remove wheel assembly from hub.

(NOTE: This decreases weight of hub assembly and reduces possibility of dirt contamination during reassembly.)

5. Remove two bolts securing caliper to knuckle. Slide caliper off disc and use a piece of wire to attach caliper to upper control arm.

CAUTION: Never allow caliper to hang from brake hose.

6. Remove dust cap, cotter pin, spindle nut, washer, and outer cone and roller assembly, Fig. 3-31.
7. Remove hub and disc assembly from steering knuckle spindle. Take care to prevent damage to spindle threads or grease seal.
8. Remove inner bearing grease seal, and bearing cone and roller assembly.

(NOTE: A simple tool, Fig. 3-33, may be made out of cold rolled steel or from an old screwdriver to facilitate removal of the grease seal. Use of this tool will prevent possible damage to inner bearing assembly and hub surface when removing seal.)

9. Inner and outer bearing cups are press fit in hub, and can be removed by driving out from opposite side with a long brass drift. Tap alternately on opposite sides of cup to avoid cocking cup and damaging inside of hub.

(NOTE: Discolored stripes on bearing cups, particularly on low mileage cars, do not necessarily indicate a rough bearing race. If stains can be removed by light polishing, replacement is not required. See Fig. 4-40.)

c. Cleaning and Inspection

1. Clean bearing cone assemblies and cups thoroughly with clean solvent. Replace complete assembly if any parts are worn, pitted, or rough.
2. Inspect bearing cups and hub surfaces carefully for nicks or small particles of foreign material. All seating surfaces must be absolutely smooth.
3. If bearing cup O.D. is scored, or if bearing cup separated very easily from housing, a loose housing fit is indicated. Examine hub bearing surfaces to assure proper bearing cup seating and fit. Replace hub and disc assembly if necessary.
4. Examine spindle bearing seats for excess wear or damage that could prevent proper slip fit seating of cone assemblies. Replace steering knuckle if necessary.

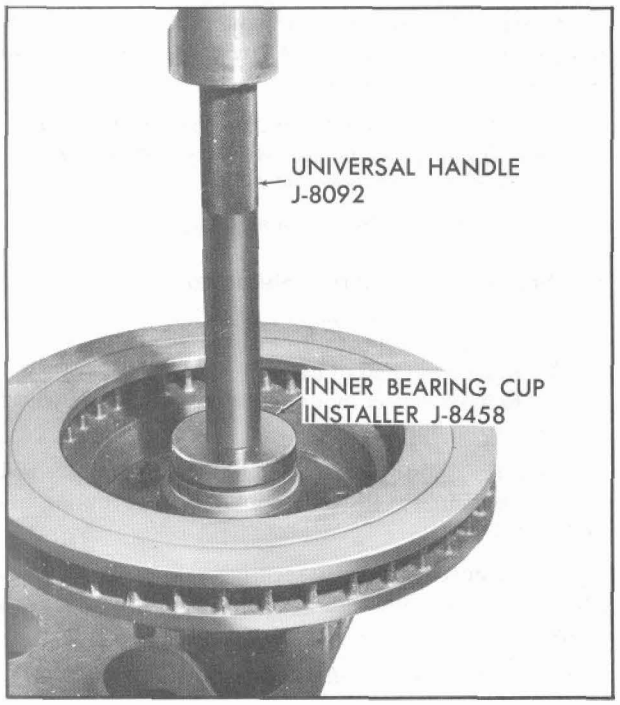


Fig. 3-35 Installing Inner Bearing Cup



Fig. 3-36 Installing Grease Retainer

d. Installation

1. Lubricate spindle and hub bore with thin film of wheel bearing grease, Part No. 9985009, to prevent rust. Excess grease should be avoided to reduce possibility of leakage.

2. Install outer bearing cup, using Front Hub Outer Bearing Cup Installer, J-8457, and Handle, J-8092. Use arbor press to install bearing cup in hub, Fig. 3-34.

3. Install inner bearing cup, using Front Hub Inner Bearing Cup Installer, J-8458, and Handle, J-8092. Use arbor press to install bearing cup in hub, Fig. 3-35.

4. Pack bearing cone and roller assemblies with high melting point grade 2 grease, Part No. 9985009. Use a commercial bearing packer or pack bearings by hand. Force grease in at large end of roller cage until grease protrudes from small end.

5. Place inner bearing cone and roller assembly in inner bearing cup.

6. Install new grease seal using a flat plate until seal is flush with hub. One way to perform this step is to screw Seal Installer, J-23114, into Universal Handle, J-8092, with flat side away from Handle. Then use arbor press to install grease retainer in hub, Fig. 3-36.

(NOTE: If working on 697 or 698, use Seal Installer, J-8456.)

7. Carefully install hub and disc assembly on spindle.

8. Place outer bearing cone and roller assembly in outer bearing cup.

9. Install washer and spindle nut, tightening nut with fingers.

10. Install caliper as described in Section 5, Note 12c, Steps 3 through 9 and Step 17.

11. Install wheel and tire assembly on hub and install wheel mounting nuts finger tight.

12. Adjust wheel bearings as in Part a.

13. Lower car and tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*

14. Install wheel disc.

FRONT COIL SPRING CHART

Style	Letter Code and Color	Normal Load	Rate per Inch
681	CE–Light Green	2800	374-396
68249 68349	CB–Yellow	2700	350-370
68247 68347	CA–Light Blue	2650	350-370
697	CG–Dark Blue	3040	471-501
698	CC–Orange	2925	582-618
Heavy Duty 681-2-3	CH–Dark Blue	2900	403-427

TORQUE SPECIFICATIONS (EXCEPT 693)

Material No.	Application	Size	Foot-Lbs.
275-M	Splash shield to steering knuckle screws	1/4-20	10
301-M	Spherical joint to knuckle (lower)	9/16-18	85*
301-M	Spherical joint to knuckle (upper)	1/2-20	60*
260-M	Stabilizer bracket to frame attaching screws	3/8-24	35
301-M	Suspension arm shaft to frame nuts (upper)	1/2-20	85*
286-M	Suspension arm shaft attaching nuts (at bushings) 1-1/4"	3/4-16	75*
301-M	Suspension arm to frame (lower)	9/16-12	95*
301-M	Front shock absorber to lower arm nut	7/16-14	55
286-M	Tie rod adjuster clamp nuts	3/8-24	22
301-M	Tie rod pivots to steering knuckle	1/2-20	37*
301-M	Tie-strut to lower arm	7/16-20	55*
284-M	Tie-strut to frame at front bushing	3/4-16	35*
NOTE:	Refer to back of Manual, page 16-1, for bolt and nut markings, and steel classifications.		

**CAUTION: These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

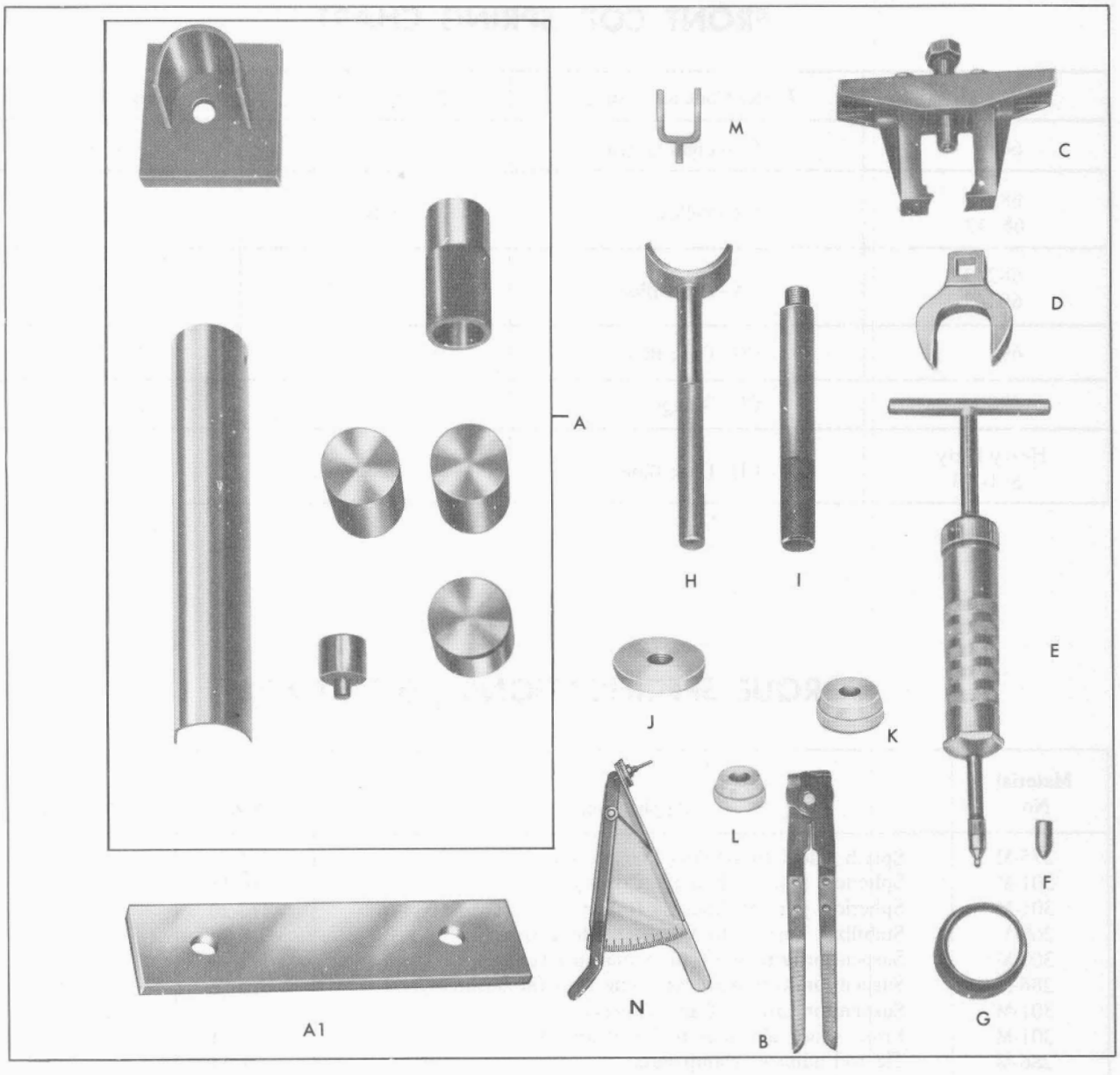


Fig. 3-37 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-8999	Front Suspension Service Set	H	J-8999-20	Spacer
A1	None	Bushing Remover Spacer (2)	I	J-8092	Universal Handle
B	J-22610	Band Installer	J	J-23114	Front Hub Grease Retainer Installer
C	J-8990	Puller Front Suspension	K	J-8458	Front Hub Inner Bearing Cup Installer
D	J-23415	Camber Adjustment Wrench	L	J-8457	Front Hub Outer Bearing Cup Installer
E	J-9280	Repacking Gun (Spherical Joints)	M	J-8999-23	Spacer
F	J-9280-5	Repacking Gun Adapter	N	J-21240-01	Spherical Joint Checking Gage
G	J-9148	Garter Spring Installer			

GENERAL DESCRIPTION

The service information that follows pertains only to the Eldorado. All other service procedures and recommendations for the Eldorado are the same as those for the standard car, as given in the first part of this section.

The front suspension on the Eldorado (693 Series), consists of two upper and two lower control arms, a stabilizer bar, shock absorbers, and a right and left torsion bar, Fig. 3-39. Torsion bars are used instead of the conventional coil springs. The front end of the torsion bar is attached to the lower control arm. The rear of the torsion bar is mounted into an adjustable arm in the torsion bar cross member. The standing height of the car is controlled by the adjuster bolt and nut that positions the adjuster arm.

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition, and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, torsion bars, suspension control arms, stabilizer bar, power steering pump hoses, and transmission cooler pipes.

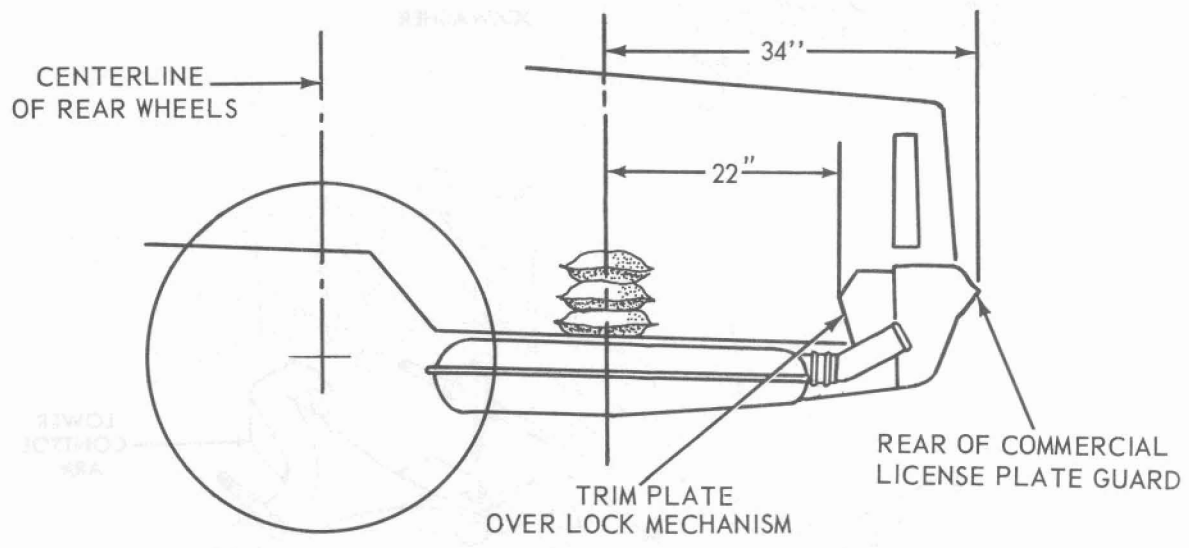
SERVICE INFORMATION

18. Standing Height Adjustment (693)

The standing height must be checked, and adjusted if necessary, before performing the front end alignment procedure. The standing height is controlled by the adjustment setting of the torsion bar adjusting bolt.

Clockwise rotation of the bolt increases the front height; counterclockwise decreases the front height.

Car must be on a level surface, gas tank full (or a compensating weight added as shown in Fig. 3-38), front seat all the way to the rear, and front and rear tires inflated to the proper pressures. Refer to Tire Pressure



	FUEL GAGE READING	AMOUNT OF WEIGHT (BAGS OF SHOT OR EQUIVALENT)
ALL SERIES	FULL	0
	3/4	40 LBS.
	1/2	80 LBS.
	1/4	120 LBS.
	ALMOST EMPTY	160 LBS.

Fig. 3-38 Compensating Weights

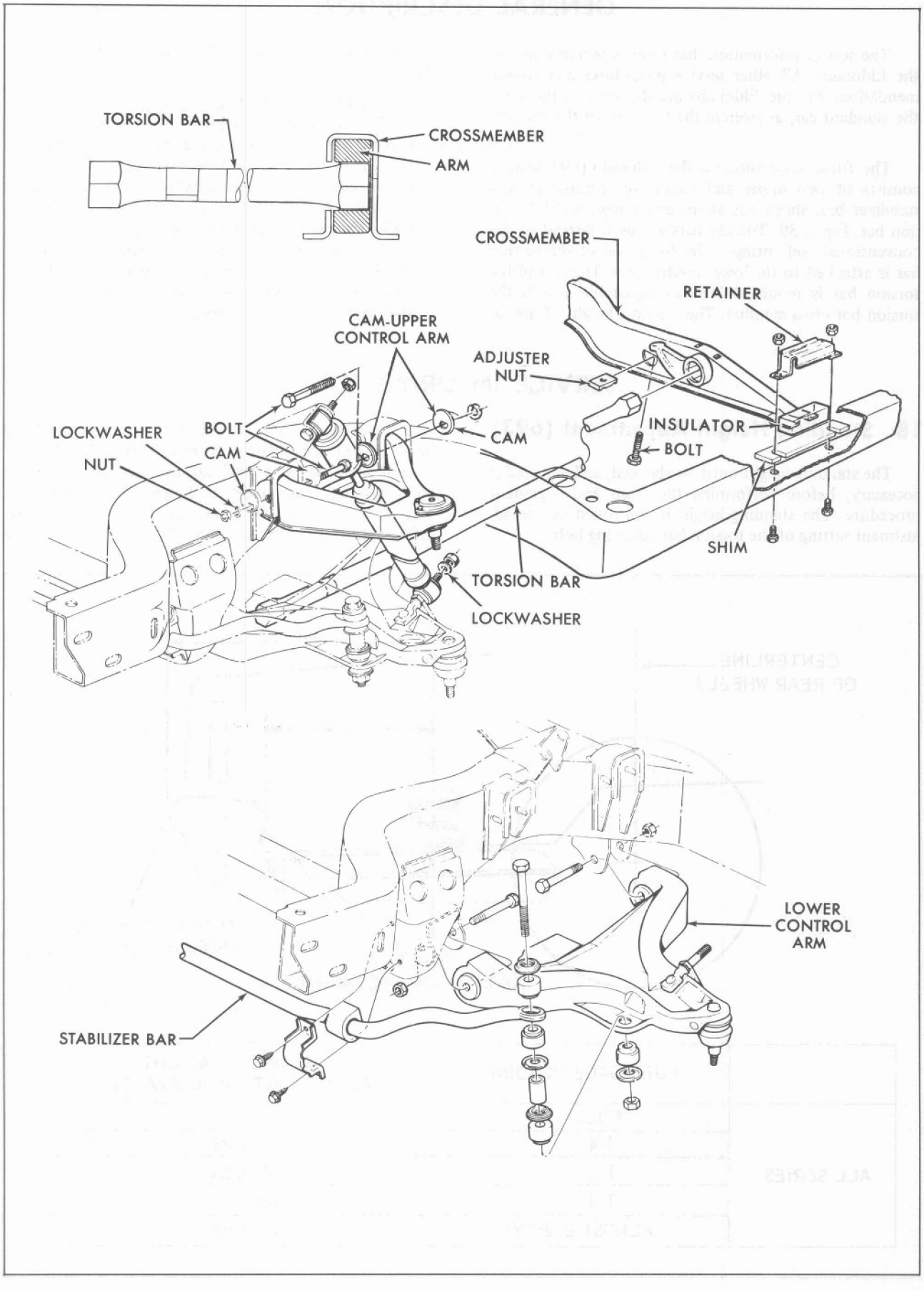


Fig. 3-39 Front Suspension Eldorado–Disassembled

Chart, Fig. 10-1. Both doors must be closed and no passengers or additional weight should be in car or trunk.

It is recommended that a wheel alignment pit be used for checking standing heights rather than channel type hoists due to the possibility of hoist deflection under vehicle weight, which distorts the standing height measurements.

To measure standing heights check the frame to axle clearance (rear) and lower edge of front shock absorber dust tube to centerline of lower attachment (front).

Standing height specifications for the Eldorado are included in Fig. 3-2.

(NOTE: Before checking rear standing height, loosen air line connection to shock absorbers to remove all air from shock absorbers. Also, be sure to bounce front of car several times, gradually reducing bouncing effort, to normalize standing height.)

After standing height is adjusted, check and adjust front wheel alignment as described in Note 19.

19. Front Wheel Alignment (693)

Satisfactory vehicle operation may occur over a wide range of front end (wheel) alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustment of alignment is advisable. The specifications stated in column 1 of the specifications chart should be used by owners, dealers, and repairmen as guidelines in vehicle diagnosis either for repairs under the new vehicle warranty or for maintenance service at customer's request. These specifications provide an acceptable all-around operating range in that they prevent abnormal tire wear caused by wheel alignment.

Governmental Periodic Motor Vehicle Inspection programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the specifications stated in column 2 of the specification chart are given and these are well within the range of safe vehicle operation.

In the event the actual settings are beyond the specifications set forth in column 1 or 2 (whichever is applicable), or whenever for other reasons the alignment is being reset, Cadillac recommends that the specifications given in column 3 of the specification chart be used.

a. Sequence of Operations

(Front wheel alignment must be checked whenever the vehicle standing height is changed.)

Front wheel alignment must be performed in the exact sequence as described in this procedure. Wheel alignment equipment manufacturers provide detailed instructions for checking wheel alignment with their alignment equipment. These instructions should be carefully followed.

In addition to the manufacturer's instructions, be sure to observe the following recommendations:

(NOTE: Car must be on a level surface, gas tank full or a compensating weight added as shown in Fig. 3-38, front seat all the way to the rear, and front and rear tires inflated to the proper pressures. Refer to Tire Pressure Chart, Fig. 10-1, Section 10. Both doors must be closed and no passengers or additional weight should be in car or trunk.)

1. Check the front standing height and adjust, if necessary. Refer to Note 18.
2. Drive car to determine whether steering wheel is properly centered. If correction is needed, mark the straight ahead position with tape so that the change required can be made during the toe-in adjustment.
3. Check front wheel alignment and adjust as required following procedure recommended by manufacturer of alignment equipment.
4. After removing vehicle from alignment machine, check the straight ahead position of the steering wheel to determine if it is properly centered. If further correction is required, repeat the toe-in portion of the wheel alignment procedure so that the necessary changes can be made.

ELDORADO WHEEL ALIGNMENT SPECIFICATIONS (AT CURB WEIGHT*)

	Specifications for Diagnosis for Warranty Repairs or Customer Paid Service	Specifications for Periodic Motor Vehicle Inspection	Specifications for Resetting Alignment
Camber	−3/4° to + 3/4°	−1-1/2° to + 1-1/2°	0° ± 3/8°
Cross Car Variation	1° Maximum	–	1/2° Maximum
Caster	− 2° to 0°	− 3° to + 1°	−1° ± 1/2°
Cross Car Variation	1° Maximum	–	1/2° Maximum
Toe-In	1/8″ Toe-Out to 1/8″ Toe-In	3/8″ Toe-Out to 3/8″ Toe-In	0″ ± 1/16″

*Curb weight means weight of vehicle including production options and full capacity of engine oil, fuel, and coolant.

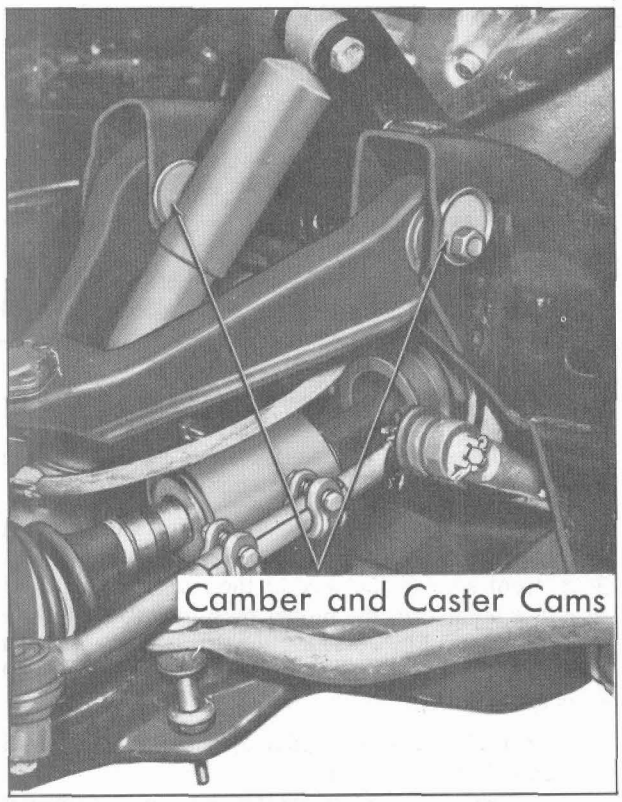


Fig. 3-40 Caster and Camber Cam Locations

b. Camber and Caster (Fig. 3-40)

(These adjustments can be made either from under car or under hood, as desired. If under hood approach is used, however, be sure to recheck alignment after all operations are completed. Change in weight distribution caused by opened hood is sufficient to disturb final alignment settings.)

1. Loosen nuts on upper control arm front and rear cam bolts.
2. Note camber reading and rotate front bolt to correct for 1/2 of incorrect reading or as near as possible.
3. Rotate rear cam bolt to bring camber reading to 0°.
4. Tighten front and rear bolts and check caster.

(NOTE: If caster requires adjustment, proceed with step 5; if not, move to step 8.)

5. Loosen front and rear cam bolt nuts.
6. Using camber scale on alignment equipment, rotate front bolt so that the camber changes an amount equal to 1/4 of the desired caster change. (A caster change-to-camber change ratio of about 2 to 1 is inherent to the Eldorado suspension system. That is, when one cam is rotated sufficiently to change camber 1°, caster reading will change about 2°.)

(NOTE: If adjusting to correct for excessive negative caster, rotate front bolt to increase positive camber. If adjusting to correct for excessive positive caster, rotate front bolt to increase negative camber.)

7. Rotate the rear bolt until camber setting returns to its corrected position (Step 3).
8. Tighten upper control arm cam nuts to 95 foot-pounds. Hold head of bolt securely; any movement of the cam will affect final setting and will require a recheck of the camber and caster adjustments. *(See CAUTION on Page 3-5.)*

c. Toe-In

Before checking toe-in, make certain that the drag link height is correct. See Section 9, Note 5 for drag link height.

Toe-in is adjusted by turning the tie-rod adjuster tubes at the outer ends of each tie rod after loosening clamp bolts. The readings should be taken only when the front wheels are in a straight ahead position so that the steering gear is on its high spot.

1. Center steering wheel, raise car, and check wheel run-out as described in Section 10, Note 4.
2. Loosen tie-rod adjuster nuts and adjust tie-rods to obtain proper toe-in setting.
3. Position tie-rod adjuster clamps so that openings of clamps are facing up. Interference with front suspension components could occur while turning if clamps are facing down.
4. Tighten tie-rod adjuster nuts to 22 foot-pounds.

20. Front Shock Absorber

a. Removal

(NOTE: Perform work on platform type hoist or garage floor so that vehicle weight is on the front suspension.)

1. Disconnect shock absorber at upper and lower mount.
2. Compress shock absorber and work lower mount free from mount bolt using a screwdriver placed inside the mount inner sleeve for leverage.
3. Guide shock absorber down and toward rear of car, and remove from car.

b. Installation

1. Guide shock absorber up through upper control arm.
2. Position shock absorber on lower attaching stud, using screwdriver inside mount inner sleeve to facilitate bushing installation.
3. Extend upper shock absorber mount into frame attaching bracket using body weight on fender to compress suspension to assist in lining up mounting holes.
4. Tighten shock absorber upper attaching nut to 75 foot-pounds.
5. Install lockwasher and lower attaching nut and tighten to 75 foot-pounds.

21. Stabilizer Bar

a. Removal

1. Place car on jack stands.
2. Remove link bolts, nuts, grommets, spacers, and retainers from lower control arm. Discard bolts and nuts.

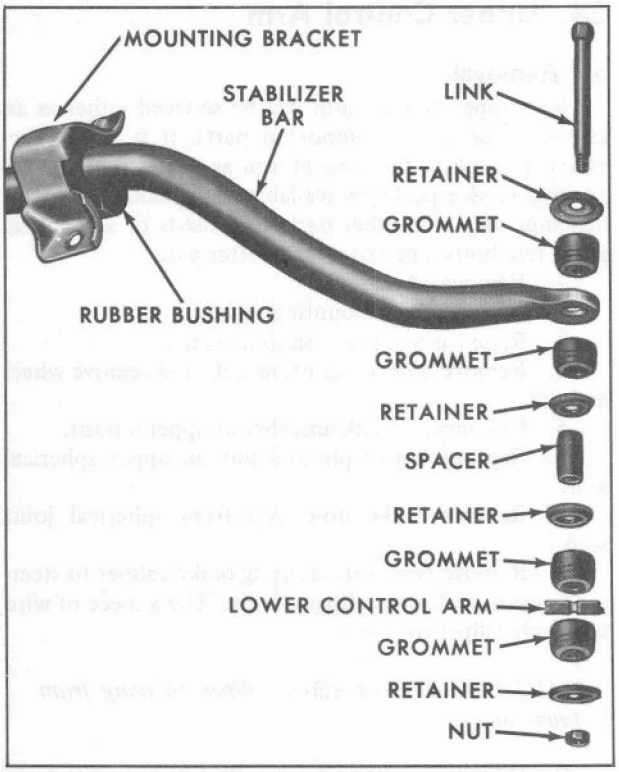


Fig. 3-41 Front Stabilizer Linkage (693)

3. Remove bracket to frame attaching bolts and remove stabilizer bar from car.

b. Installation

1. Position stabilizer bar in place on car.
2. Assemble grommets, spacers, and retainers on new link bolt as shown in Fig. 3-41.
3. Position link bolt on lower control arm, and install remaining grommet, retainer, and nut.
4. Install stabilizer to frame brackets.
5. Tighten stabilizer link nuts to 13 foot-pounds.
6. Cut link bolts off so that they protrude 1/4" past nut.

22. Spherical Joint Checking Procedure

1. Raise car and position jack stands under lower control arms as near as possible to each spherical joint. Car must be stable and should not rock on floor stands.
2. Clamp self-locking pliers on hub to drive axle nut so that self-locking pliers are in horizontal position, Fig. 3-42.
3. Construct a sturdy stand and install Dial Indicator, J-8001, so that indicator is horizontal and button contacts pliers, Fig. 3-42. Set dial to 0.
4. Place a pry bar between lower control arm and drive axle outer race as shown in Fig. 3-43, and pry down on bar. If reading exceeds .125" replace lower spherical joint, Note 31. (Very little prying effort is necessary to make this check. Often, weight of pry bar itself is all that is required.)

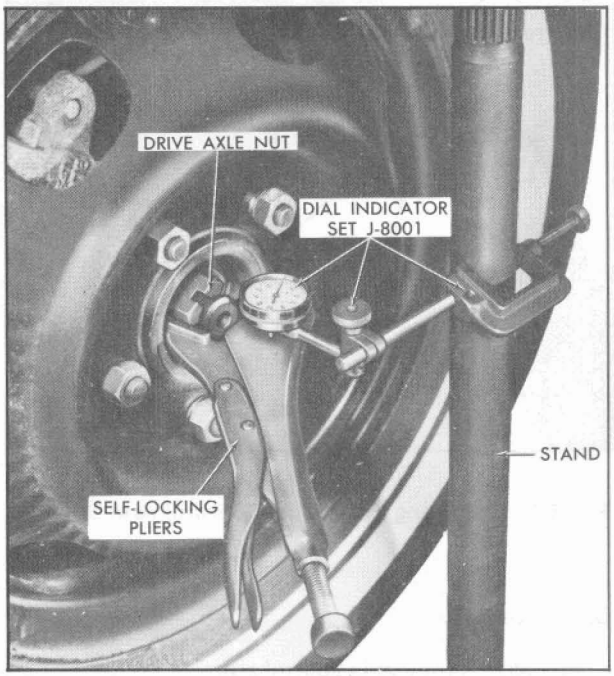


Fig. 3-42 Checking Spherical Joint End Play (693)

CAUTION: When positioning pry bar, use extreme caution to avoid contact with drive axle seal, as seal may become damaged internally.

23. Upper Control Arm Bushing (On Car)

a. Removal

The upper control arm bushings can be removed and installed on or off the car.

1. Remove wheel disc.
2. Loosen wheel mounting nuts.
3. Raise car and remove wheel and tire.
4. Disconnect shock absorber at upper mount and remove nut and bolt.
5. Remove upper control arm cam assemblies and nuts.
6. Remove upper control arm from frame mounts.
7. Attach bushing removal tools as shown in Fig. 3-44.
8. Remove bushings and remove tools.

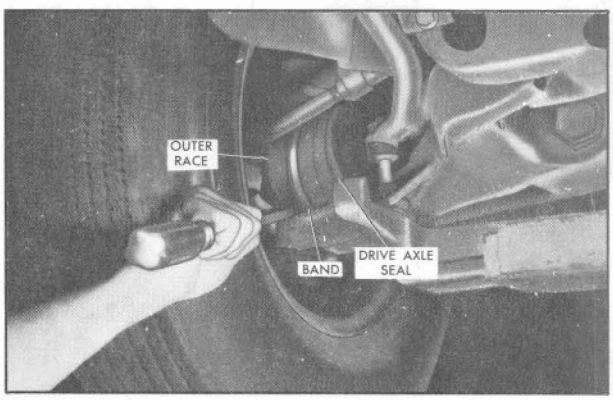


Fig. 3-43 Prying at Drive Axle Outer Race

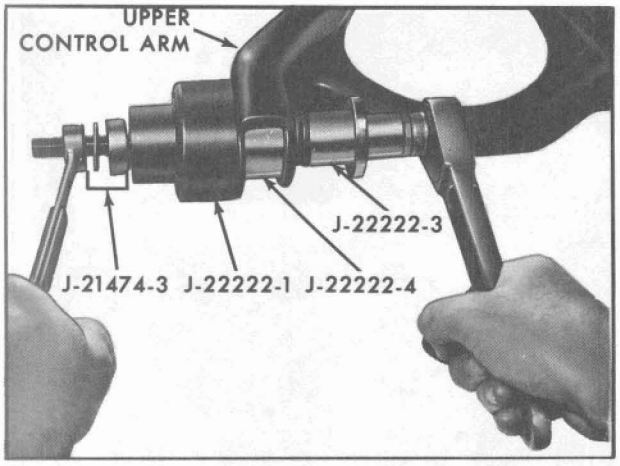


Fig. 3-44 Removing Front Upper Control Arm Bushings

b. Installation

1. Place bushings in control arm.
2. Install tools as shown in Fig. 3-45 and press bushings into control arm.
3. Remove bushing installation tools.
4. Guide upper control arm over shock absorber and install bushing ends into frame mounts.
5. Install cam assemblies as shown in Fig. 3-40. Both front and rear cams should be mounted with bolt hole downward.
6. Install shock absorber in upper mount. Tighten nut to 75 foot-pounds.
7. Install wheel and tire.
8. Lower car and tighten wheel nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*
9. Check standing height as described in Note 18 and adjust if necessary.
10. Adjust toe-in, caster, and camber as described in Note 19.
11. Install wheel disc.

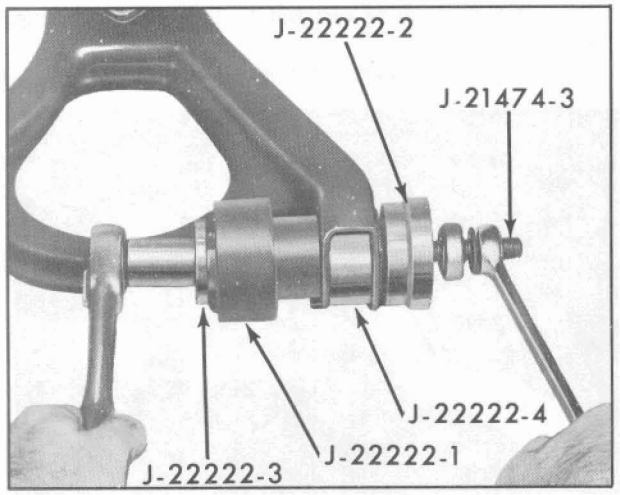


Fig. 3-45 Installing Front Upper Control Arm Bushings

24. Upper Control Arm

a. Removal

The upper control arm can be serviced either as an assembly, or by its component parts. If it is not necessary to replace the control arm as an assembly, there are two service packages available. One package contains bushings only, the other package consists of a spherical joint, two bolts, one nut, and a cotter pin.

1. Remove wheel disc.
2. Loosen wheel mounting nuts.
3. Raise car and place on jack stands.
4. Remove wheel mounting nuts and remove wheel and tire.
5. Disconnect shock absorber at upper mount.
6. Remove cotter pin and nut on upper spherical joint.
7. Remove brake hose clip from spherical joint stud.
8. Remove two bolts securing brake caliper to steering knuckle and slide caliper off disc. Use a piece of wire to attach caliper to frame.

CAUTION: Do not allow caliper to hang from brake line.

9. Disengage spherical joint stud and remove from steering knuckle.
10. Remove upper control arm cam assemblies and remove control arm from car.

b. Installation

1. Guide upper control arm over shock absorber and install bushing ends into frame mounts.
2. Install cam assemblies as shown in Fig. 3-40. Both cams should be mounted with bolt hole downward.
3. Install shock absorber in upper mount. Tighten nut to 75 foot-pounds.
4. Install upper spherical joint into steering knuckle.
5. Install brake caliper following procedure in Section 5, Note 12c, Steps 3 through 9, and Step 17.

CAUTION: Do not twist brake hose on installation.

6. Install brake hose clip, nut, and cotter pin on upper spherical joint stud. Tighten nut to 60 foot-pounds. *(See CAUTION on Page 3-5.)*

CAUTION: Cotter pin must be crimped toward upper control arm to prevent damage to the outer constant velocity joint seal. If cotter pin cannot be installed in this position, tighten nut further until insertion is possible.

7. Install wheel and tire. Tighten nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*
8. Raise car. Remove jack stands and lower car.
9. Check standing height as described in Note 18 and adjust.
10. Check caster, camber, and toe-in as described in Note 19 and adjust.

25. Upper Control Arm Spherical Joint

a. Removal

1. Remove upper control arm as described in Note 24a.
2. Place upper control arm on workbench and grind the heads off three rivets.
3. Using a hammer and punch, drive on center of rivets until spherical joint can be removed from control arm.

b. Installation

1. Install new spherical joint in upper control arm.
2. Install three bolts in top side of control arm.
3. Install three nuts from under side of control arm. Tighten nuts to 9 foot-pounds.
4. Install upper control arm as described in Note 24b.
5. Lubricate the spherical joint fitting until grease escapes between seal and steering knuckle, Fig. 3-46.

26. Torsion Bar

a. Removal

1. Raise car so that front suspension is allowed to hang at full rebound position.
2. Remove adjusting bolt from both torsion bar locknuts.
3. Install Torsion Bar Remover and Installer, J-22517, on torsion bar cross member, Fig. 3-47.

(NOTE: Install Torsion Bar Remover U-bolt on cross member. If clearance is insufficient, pry between cross member and underbody until tool falls in place, Fig. 3-48. Next, install Torsion Bar Remover Base on U-bolt and install two locknuts on U-bolt. Make certain Base is installed flush with last thread on U-bolt and install center bolt.)

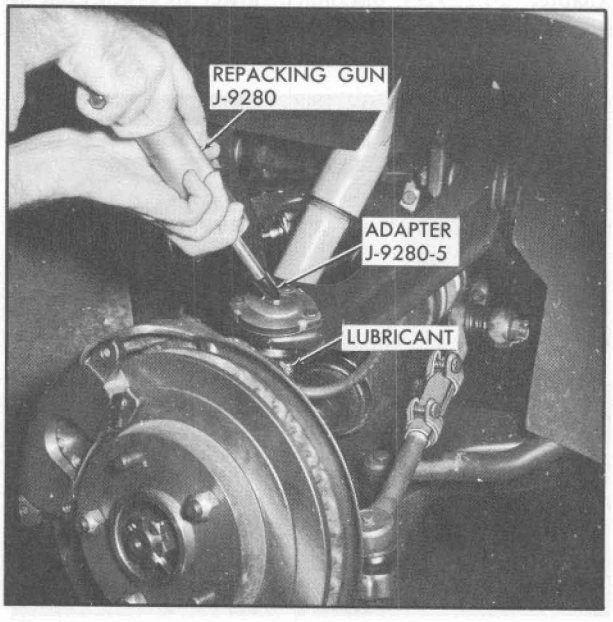


Fig. 3-46 Repacking Upper Spherical Joint (693)

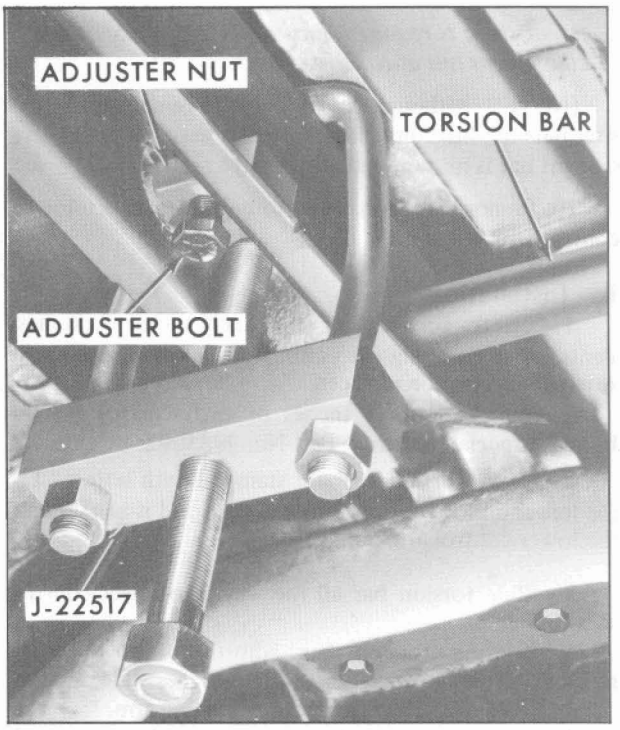


Fig. 3-47 Removing and Installing Torsion Bar

4. Tighten center bolt until torsion bar adjusting arm is raised high enough to permit removal of locknut. Remove locknut.
5. Repeat Steps 3 and 4 on other end of cross member and remove tool from cross member.
6. Remove parking brake cable from guide at right side of underbody.
7. Remove torsion bar cross member bolts, nuts, shim, and retainer from both ends of cross member.
8. Move cross member as far as possible toward the side opposite the side from which torsion bar is to be removed. One end of cross member should now be clear of frame.
9. Lower end of cross member from frame, then drive cross member rearward until torsion bar is free of cross member.

CAUTION: Take care not to damage parking brake cable when lowering cross member. If addi-

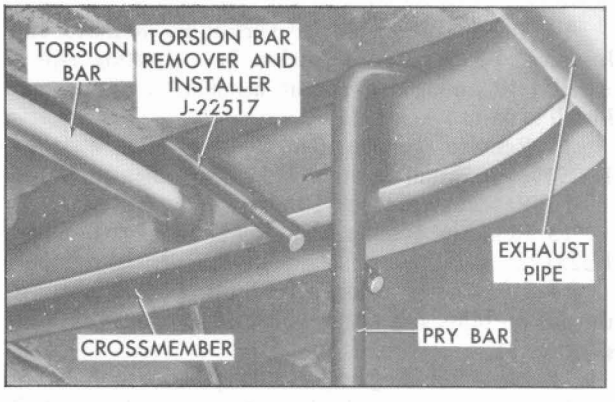


Fig. 3-48 Prying at Crossmember and Underbody

tional slack is required, loosen parking brake cable adjustment nut at equalizer.

(NOTE: Although it is possible to remove both torsion bars at this point, installation is easier if either left or right bar is mounted at all times.)

10. Remove torsion bar from connector at lower control arm.

b. Installation

1. Check torsion bar for deep nicks, scratches, dents, or splits along the seam. If these conditions exist, torsion bar must be replaced.
2. Lubricate three inches of each end of torsion bar with special lubricant, Part No. 9985092.

(NOTE: Torsion bars are stamped with letters "L" for left and "R" for right. the stamped end is installed in the lower control arm connector.)

3. Slide torsion bar all the way into lower control arm connector.
4. Position torsion bar adjusting arm in cross member. Holding adjusting arm in place, slide torsion bar rearward until bar is seated in adjusting arm.

At this point, tape on torsion bar near lower control arm connector should be fully visible but within 1/4" of connector.

5. Position cross member on frame.

(NOTE: If both torsion bars are to be removed, remove opposite bar at this time following procedure of Part a, beginning with Step 8.)

6. Install shim between cross member and frame on each side, and install retainer over cross member insulator.
7. Check both torsion bar adjusting arms for identical position with respect to torsion bar and cross member. Install cross member bolts and nuts, tightening to 12 foot-pounds.
8. Install parking brake cable through guide at right side of underbody. If cable was loosened at equalizer, adjust at this time.
9. Install Torsion Bar Remover and Installer, J-22517, Fig. 3-47.

(NOTE: When installing Torsion Bar Remover and Installer, J-22517, follow steps 3 and 4 of Part a of this procedure.)

10. Tighten center bolt on Torsion Bar Remover and Installer, J-22517, until torsion bar adjusting arm is raised high enough to permit installation of locknut. Install locknut.
11. Remove Torsion Bar Remover and Installer, J-22517, and install on other end of cross member.
12. Repeat steps 9 and 10 for other torsion bar.
13. Remove Torsion Bar Remover and Installer, J-22517.
14. Using new torsion bar adjusting bolts, lubricate threads on bolts and install bolts into locknuts on both sides of car.
15. Check standing height and adjust as required.
16. Check front wheel alignment and adjust if necessary.

27. Steering Knuckle and Inner Seal

a. Removal

1. Remove wheel disc.
2. Remove drive axle cotter pin and loosen nut.
3. Loosen wheel mounting nuts.
4. Raise car and place jack stands under lower control arms.
5. Remove drive axle to hub nut and washer and wheel mounting nuts.
6. Remove wheel and tire.
7. Remove upper spherical joint cotter pin and nut.
8. Remove brake line hose clip from upper spherical joint stud, but do not loosen spherical joint stud.
9. Install one or two wheel mounting nuts to prevent disc from falling off hub while removing caliper.
10. Remove two bolts securing caliper to knuckle and slide caliper off knuckle.

CAUTION: Never suspend caliper by brake hose. Use a length of wire to attach caliper to frame.

11. Remove nuts used to retain disc. Mark hub and disc for alignment on assembly and remove disc from hub.
12. Place a short length of rubber hose over the lower control arm torsion bar connector to avoid damage to inboard tri-pot joint seal lip, Fig. 3-49.
13. Position brake hose out of way and, using hammer, strike steering knuckle in area of upper spherical joint and loosen upper spherical joint stud.

CAUTION: Use care to prevent hammer from slipping and hitting brake hose or caliper.

14. Remove cotter pin and nut from tie-rod end.
15. Remove tie-rod end from steering knuckle using Tie Rod End Puller, J-21930.
16. Remove cotter pin and nut from lower spherical joint stud.
17. Using Spherical Joint Puller, J-22292, and Adapter, J-22292-3, disconnect lower spherical joint at steering knuckle.

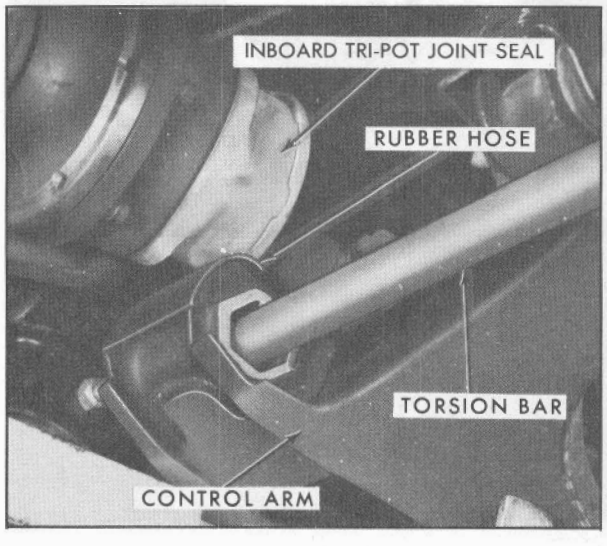


Fig. 3-49 Rubber Hose Location

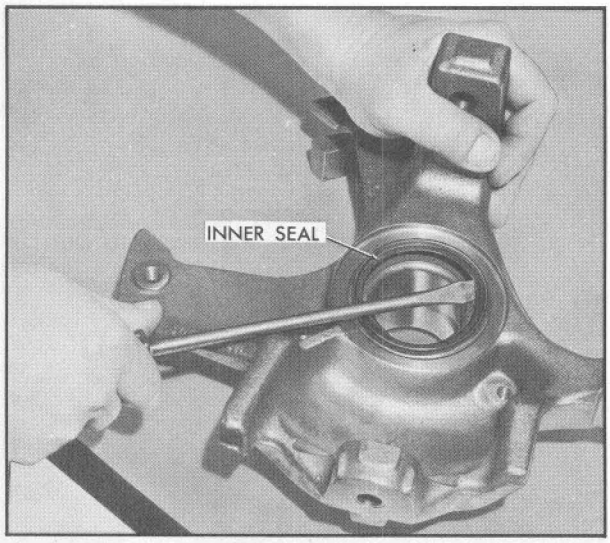


Fig. 3-50 Removing Steering Knuckle Inner Seal

CAUTION: Use extreme care when installing Adapter, J-22292-3, between spherical joint seal and steering knuckle.

18. Guide hub and knuckle assembly over end of drive axle and remove from car.

(NOTE: If knuckle is being replaced, remove hub, bearings, cups, and seals as described in Note 32.)

19. To remove steering knuckle inner seal, use a screwdriver, Fig. 3-50.

b. Cleaning and Inspection

Inspect seal surface in the steering knuckle bore and the seal contact surface on the drive axle. Remove any rust present, using #400 grit "wet" paper and kerosene. When sanding, use a circular motion only, to avoid spiral marks on sealing surfaces.

c. Installation

If knuckle is being replaced, install hub, bearings, bearing cups, and seals as described in Note 32 before beginning this procedure.

1. Apply a moderate amount of high melting point sodium base grease between lips of steering knuckle inner seal, Fig. 3-51.
2. Undercut webbing on Seal Installer, J-23115, so that Installer will accept seal.
3. Install seal on Seal Installer, J-23115.
4. Position knuckle and hub assembly on arbor press, Fig. 3-52.

(NOTE: Support hub and knuckle assembly so that assembly is not supported by the wheel mounting studs.)

5. Position seal and Seal Installer, J-23115, on knuckle and press seal into knuckle, Fig. 3-52.
6. Align splines in hub with splines on drive axle and install hub and knuckle assembly on drive axle.
7. Install lower spherical joint stud into steering knuckle and attach nut. Do not tighten nut at this time.
8. Install tie-rod end stud into knuckle and attach nut. Do not tighten nut at this time.



Fig. 3-51 Lubricating Steering Knuckle Seal

9. Install upper spherical joint stud into knuckle and install upper spherical joint nut loosely.
10. Using alignment marks placed on hub and disc at time of disassembly, align and install disc on hub.
11. Loosely install two nuts on hub to prevent disc from falling off hub.
12. Install caliper as described in Section 5, Note 12c, Steps 3 through 9, and Step 17.

CAUTION: Do not twist brake hose on installation.

13. Remove upper spherical joint nut to install brake hose clip on stud.

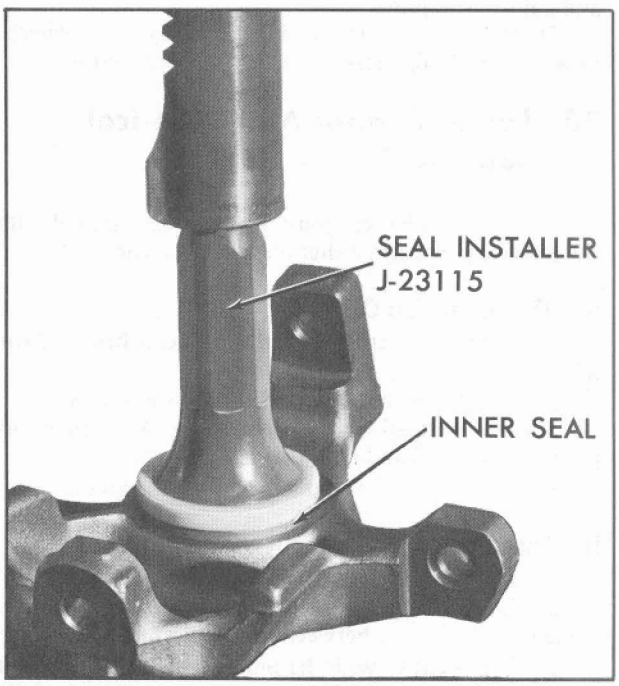


Fig. 3-52 Installing Inner Seal in Knuckle

14. Install upper spherical joint nut, tighten nut to 60 foot-pounds, and install new cotter pin. Bend cotter pin tight against flats on nut. *(See CAUTION on Page 3-5.)*

(NOTE: If cotter pin cannot be installed, tighten nut to next hole and install cotter pin.)

CAUTION: Cotter pin must be crimped tight against flat on nut to prevent interference with or damage to the drive-axle constant velocity joint or seal.

15. Tighten tie-rod end nut to 40 foot-pounds and install new cotter pin. *(See CAUTION on Page 3-5.)*

16. Tighten nut on lower spherical joint stud to 80 foot-pounds and install new cotter pin. *(See CAUTION on Page 3-5.)*

(NOTE: If cotter pin cannot be installed, tighten nut to next hole.)

17. Remove rubber hose from lower control arm torsion bar connector, Fig. 3-49.

18. Install drive axle washer and nut. Do not tighten nut at this time.

19. Install wheel and tire.

20. Install wheel mounting nuts; turn up snug, but do not tighten nuts at this time.

21. Raise car, remove jack stands, and lower car.

22. Tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*

23. Tighten drive axle to hub nut to 150 foot-pounds and install new cotter pin. *(See CAUTION on Page 3-5.)*

(NOTE: If cotter pin cannot be installed, tighten nut to next hole.)

24. Install wheel disc.

25. Check standing height and front end alignment and adjust as required.

26. With vehicle weight supported by front wheels, inspect front brake hose to be sure it is not twisted.

28. Lower Control Arm Spherical Joint Seal

The lower spherical joint seal can be installed with the lower control arm either on or off the car.

a. Removal (On Car)

1. Remove steering knuckle as described in Note 27a.
2. Using a hammer, tap lightly on seal retainer.
3. Use a small screwdriver to work retainer off joint. Discard seal and retainer.
4. Wipe grease from spherical joint and stud.

b. Installation

1. Position new seal over spherical joint stud.
2. Lubricate jaws of Camber Adjusting Wrench, J-9231, and slide jaw between seal and retainer.
3. Tap lightly with hammer on end of Camber Adjusting Wrench, J-9231, until seal retainer is fully seated.

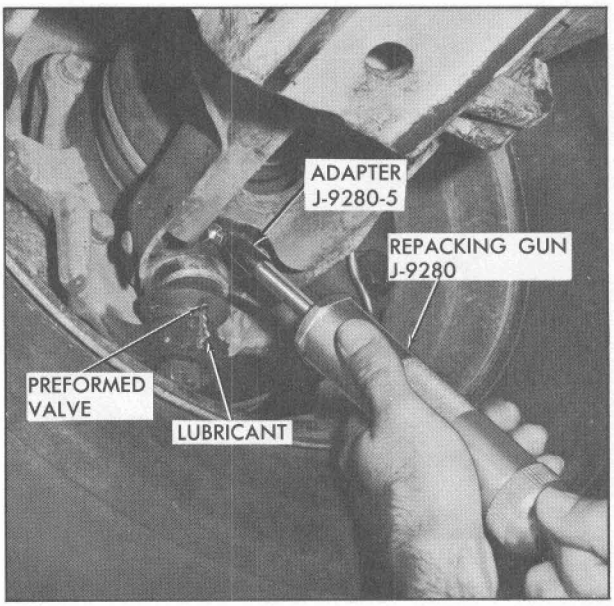


Fig. 3-53 Repacking Lower Spherical Joint Seal

4. Install steering knuckle as described in Note 27b.
5. Lubricate spherical joint fitting until grease escapes from valve inside of seal, Fig. 3-53.

29. Lower Control Arm

The lower control arm components are serviced as individual parts.

a. Removal

1. Remove wheel disc.
2. Loosen wheel mounting nuts
3. Remove hub cotter pin and loosen nut.
4. Raise car.
5. Remove wheel and tire.
6. Remove torsion bar as described in Note 26a.
7. Remove hub nut and washer.
8. Remove brake hose clip(s) attached to frame.

(NOTE: Right side of car has two frame attaching clips.)

9. Remove cotter pin, nut, and brake hose clip from upper spherical joint stud.

10. Using a hammer, strike knuckle in area of upper spherical joint and remove joint from steering knuckle.

CAUTION: Use care to prevent hammer from slipping and hitting brake hose.

11. Disconnect shock absorber at lower mount, then work shock off mount using a screwdriver to pry bushing off stud.

12. Using Tie Rod End Puller, J-21930, disconnect tie rod end at steering knuckle.

13. Disconnect stabilizer bar and disconnect nut and link bolt.

14. Using Spherical Joint Puller, J-22292, and Adapter, J-22292-3, disconnect lower spherical joint.

15. Disengage hub, knuckle, and disc as an assembly from drive axle and secure assembly to upper control arm with a piece of wire.

CAUTION: Take care to avoid damaging brake hose.

16. Remove lower control arm to frame attaching nuts and bolts.

17. Disengage lower control arm from frame mounts and remove control arm.

b. Installation

1. Remove wire and install hub, disc, and knuckle assembly on drive axle.

2. Install lower control arm into mounts in chassis. Do not tighten nuts at this time.

3. Install lower control arm spherical joint into steering knuckle. Tighten nut to 80 foot-pounds and install new cotter pin. *(See CAUTION on Page 3-5.)* (If pin cannot be installed, tighten nut to next hole and install cotter pin.)

4. Tighten lower control arm inner mount bolts to 80 foot-pounds. *(See CAUTION on Page 3-5.)*

5. Lift up upper control arm and install shock absorber on lower control arm mount. Tighten nut to 75 foot-pounds.

6. Install upper control arm spherical joint into steering knuckle.

7. Install brake hose clip on upper spherical joint stud. Tighten nut to 60 foot-pounds and install new cotter pin. *(See CAUTION on Page 3-5.)* (If pin cannot be installed, tighten nut to next hole. Cotter pin must be crimped tight against flats on nut to prevent cotter pin from interfering with outer constant velocity joint seal.)

8. Install brake hose clip(s) to frame. (Right side of car has two frame attaching clips.)

9. Install tie rod end in steering knuckle. Tighten nut to 40 foot-pounds, and install new cotter pin. *(See CAUTION on Page 3-5.)* (If pin cannot be installed, tighten nut to next hole.)

10. Install stabilizer bar on control arm as described in Note 21b.

11. Install washer and nut securing hub to drive axle.

12. Install torsion bar as described in Note 26b.

13. Install wheel and tire.

14. Lower car and examine brake lines to be sure they are not twisted.

15. Tighten drive axle nut to 150 foot-pounds and install new cotter pin. *(See CAUTION on Page 3-5.)*

(NOTE: If cotter pin cannot be installed, tighten nut to next hole location and install cotter pin.)

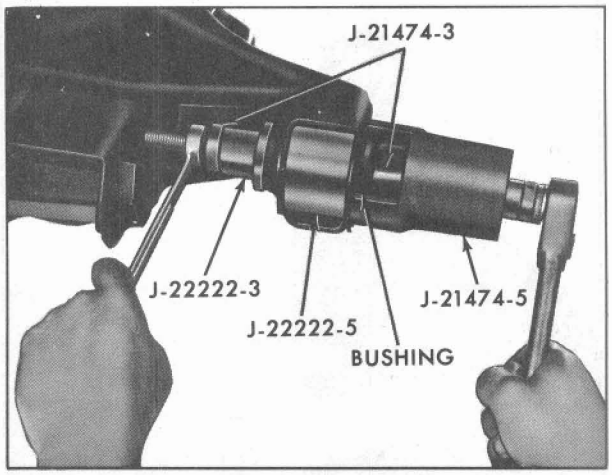


Fig. 3-54 Removing Front Lower Control Arm Bushings

16. Tighten wheel nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*

17. Adjust standing height and front wheel alignment as described in Notes 18 and 19.

18. Install wheel disc.

30. Lower Control Arm Bushings

a. Removal

1. Remove lower control arm as described in Note 29a.

2. Install tools as shown in Fig. 3-54 and press bushings out of control arm.

b. Installation

1. Install tools as shown in Fig. 3-55, and press bushings into lower control arm.

2. Install lower control arm as described in Note 29b.

3. Check standing height and front wheel alignment and adjust as necessary, Notes 18 and 19.

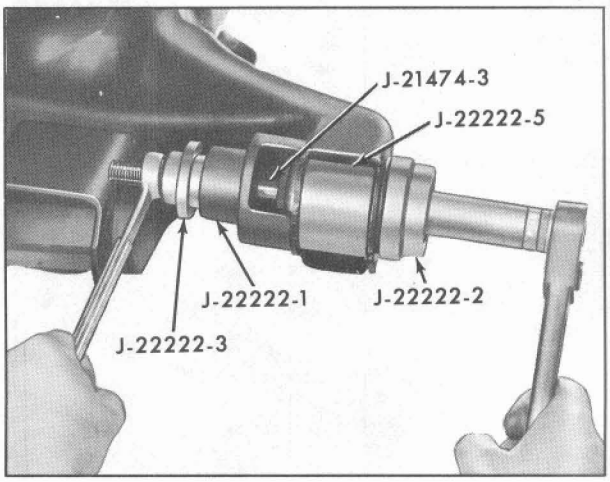


Fig. 3-55 Installing Front Lower Control Arm Bushings

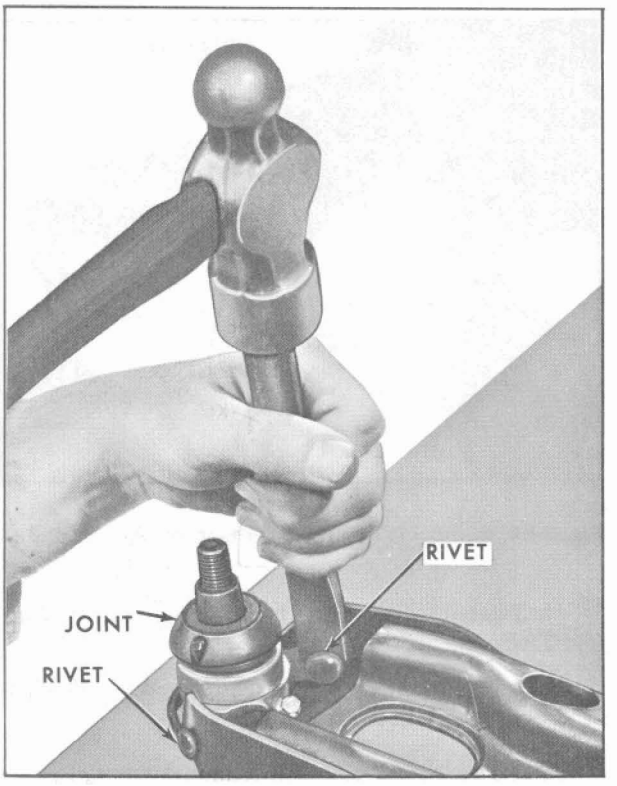


Fig. 3-56 Removing Lower Spherical Joint Rivets

31. Lower Control Arm Spherical Joint

a. Removal

1. Remove lower control arm as described in Note 29a.
2. Place lower control arm on bench with spherical joint stud up.
3. Using a chisel, cut two rivet heads off as shown in Fig. 3-56.
4. Place lower control arm right side up and grind large rivet head off as shown in Fig. 3-57.
5. Using a hammer and punch, drive on center rivet of joint until joint is out of control arm.

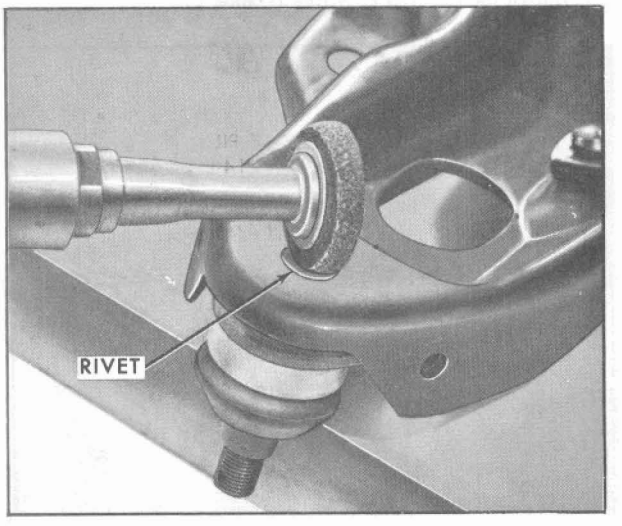


Fig. 3-57 Removing Lower Spherical Joint Center Rivet

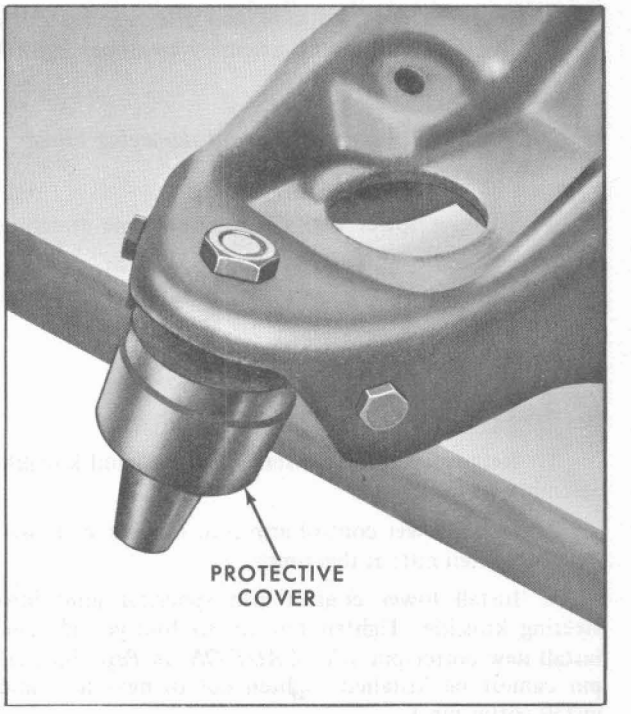


Fig. 3-58 Lower Spherical Joint Installed

b. Installation

1. Install service spherical joint into control arm and tighten bolts and nut as shown in Fig. 3-58.
2. Install lower control arm as described in Note 29b.

32 Hub, Bearing, and Retainer (Fig. 3-59)

a. Removal

1. Remove wheel disc.
2. Loosen wheel mounting nuts.
3. Remove drive axle cotter pin.
4. Loosen drive axle nut.
5. Raise car and place jack stands under lower control arms.
6. Remove drive axle nut, washer, and wheel mounting nuts, and remove wheel and tire.
7. Remove upper spherical joint cotter pin and loosen nut. Remove nut and brake hose clip from stud, then re-install nut.
8. Remove two bolts securing caliper to knuckle and slide caliper off disc.
9. Position brake hose and caliper out of way.

CAUTION: Do not allow caliper to hang from the brake hose.

10. Mark hub and disc for alignment on assembly and remove disc.
11. Strike steering knuckle in area of upper spherical joint until upper spherical joint is loose.

CAUTION: Use extreme care to prevent hammer from slipping and hitting brake hose.

12. Install a short length of rubber hose over the lower control arm torsion bar connector to avoid

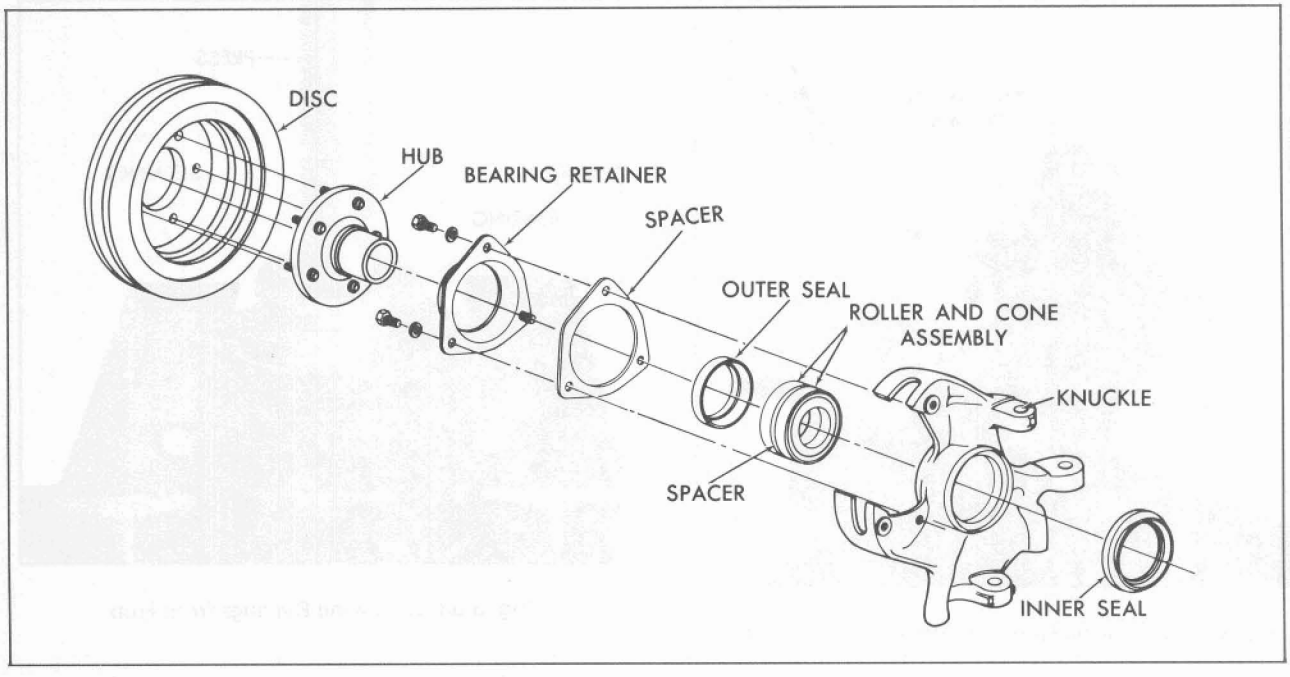


Fig. 3-59 Front Hub, Bearing, and Retainer (693)

damage to inboard tri-pot joint seal lip when hub and knuckle are removed, Fig. 3-49.

13. Remove tie rod end cotter pin and nut.

14. Using Tie Rod End Puller, J-21930, disconnect tie rod end at steering knuckle.

15. Remove lower spherical joint cotter pin and nut.

16. Using Spherical Joint Puller, J-22292, and Adapter, J-22292-3, disconnect lower spherical joint.

17. Remove upper spherical joint nut.

18. Remove upper spherical joint stud from steering knuckle.

19. Remove hub and knuckle as an assembly.

b. Disassembly

1. Remove three screws and washers securing spacer and bearing retainer to steering knuckle and remove spacer.

2. Remove steering knuckle inner seal, Fig. 3-50, and discard seal.

CAUTION: Use care when removing seal to prevent damage to the seal mating surface on the steering knuckle.

3. Install Small Bushing, part of set J-22214-10, in upper end of steering knuckle.

4. Install Large Bushing, part of set J-22214-10, in lower end of steering knuckle.

5. Install Large Pilot, J-22214-8, on inner end of hub, Fig. 3-60.

6. Install Knuckle Remover, J-22214-5, between upper and lower ends of steering knuckle, Fig. 3-60.

7. Secure Knuckle Remover to steering knuckle by installing two Small Bolts, J-22214, through bushings previously installed.

8. Secure Knuckle Remover, J-22214-5, in a vise, with knuckle assembly attached, Fig. 3-61.

9. Coat Large Bolt, J-22214-4, with chassis lubricant and install bolt in Knuckle Remover, J-22214-5.

10. Tighten Large Bolt, J-22214-4, until hub, bearing, retainer, steering knuckle outer seal, and bearing assembly are pressed out of steering knuckle.

11. Pry outer seal away from bearing package, Fig. 3-62.

(NOTE: A simple tool such as the one described in Fig. 3-33 is ideal for this prying operation. This can be made from an old screwdriver or a piece of cold rolled steel.)

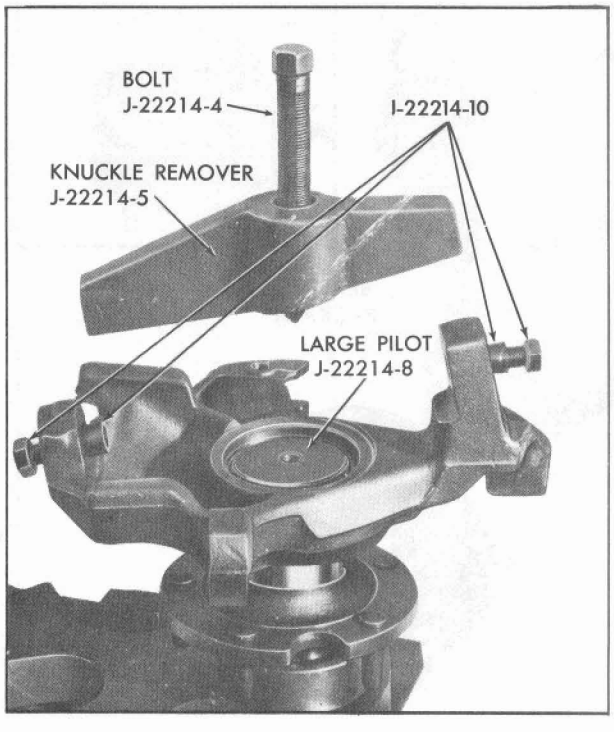


Fig. 3-60 Hub and Bearing Removal Tools

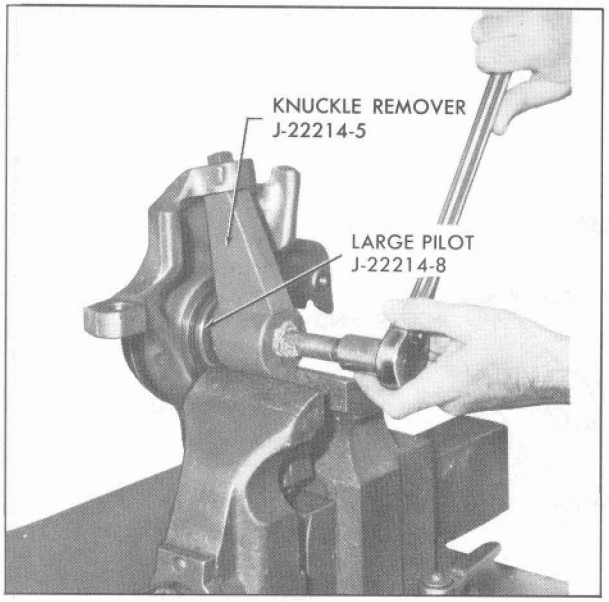


Fig. 3-61 Removing Hub and Bearings from Knuckle

12. Use a hammer and a 3/8" chisel to cut through outer seal. Then remove seal from bearings, Fig. 3-62.

CAUTION: When chiseling, hold hammer and chisel in a strictly vertical position to avoid damaging hub.

13. Place assembly in arbor press so that hole in Press Plate, J-23997, lines up with hole in anvil. Press bearings from hub, Fig. 3-63.

c. Assembly

The front wheel bearings are supplied as matched assemblies and must be serviced as complete assemblies.

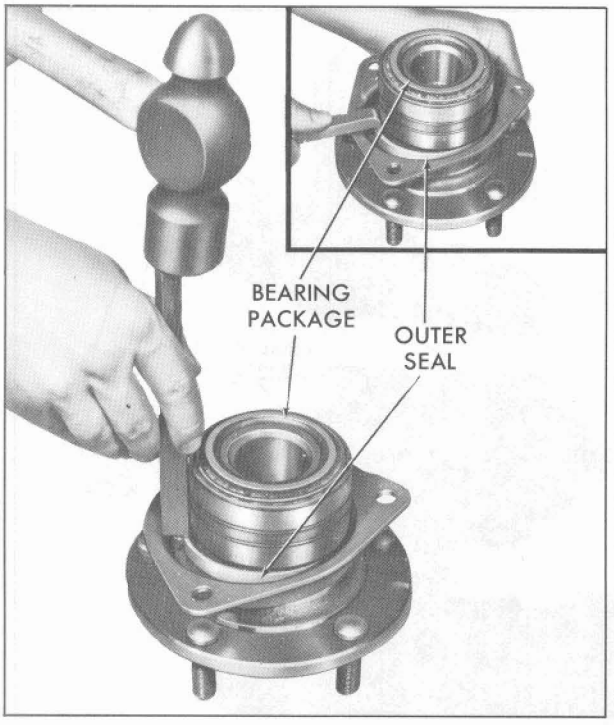


Fig. 3-62 Removing Outer Seal from Bearings

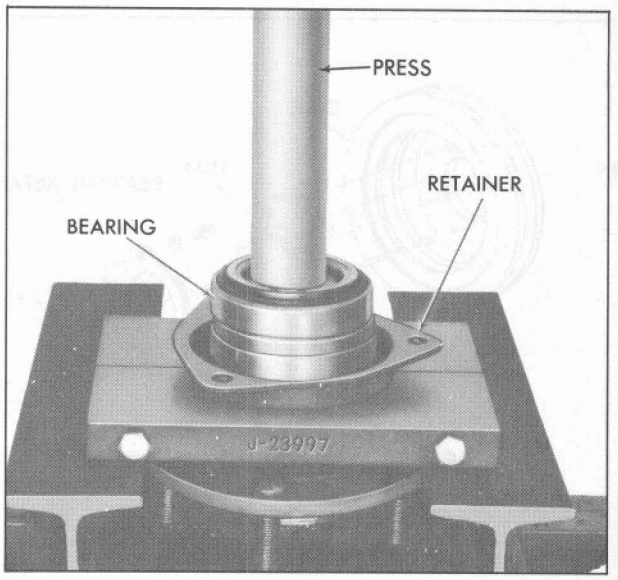


Fig. 3-63 Removing Bearings from Hub

Inspect the steering knuckle bore and the steering knuckle seal contact surface on the drive axle. Remove any rust present using #400 grit "wet" paper and kerosene. When sanding, use a circular motion only to avoid spiral marks on sealing surface.

1. Position steering knuckle on arbor press with outboard face of knuckle facing up.
2. Using special lubricant provided in bearing package, apply lubricant to hub shaft and between lips of both steering knuckle seals, Fig. 3-51.

(NOTE: One tube of lubricant will service one complete hub and knuckle assembly.)

3. Install outer steering knuckle seal on Seal Installer, J-23114.
4. Position seal and seal installer on bearing package and position package in steering knuckle bore.

CAUTION: Do not remove disposable sleeve in bearing package at this time, as sleeve is used as a retainer to prevent bearings from being mispositioned in cups, or damaged during installation, Fig. 3-64.

5. Press bearing package and outer seal into steering knuckle, Fig. 3-65. Bearing package and outer seal are installed when inner bearing cup bottoms out on shoulder in steering knuckle bore.
6. Position spacer on outer face of steering knuckle.
7. Position bearing retainer over spacer and secure bearing retainer and spacer to steering knuckle with three screws and washers. Tighten screws to 30 foot-pounds. Remove knuckle assembly from press.
8. Remove disposable sleeve from bearing package previously installed in steering knuckle.
9. Working from inner face of steering knuckle, use remainder of special lubricant to coat inner race of bearings before installing hub in knuckle and bearing assembly.

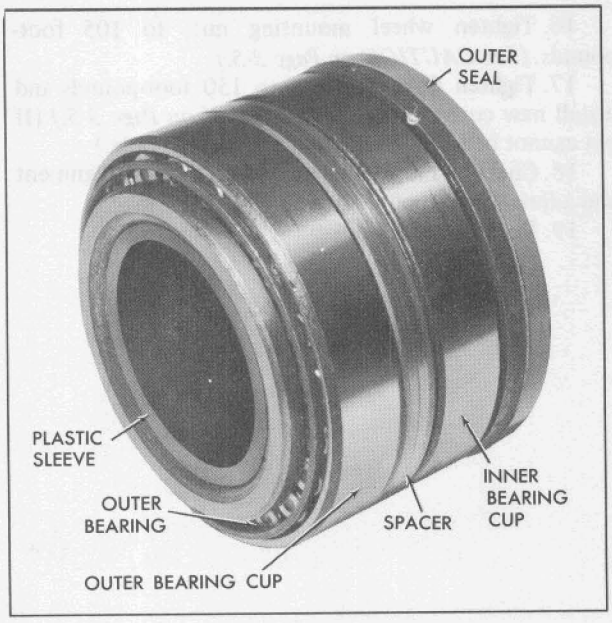


Fig. 3-64 Bearing Package

10. Position hub on arbor press with stud end down.

CAUTION: Support hub so that hub is not supported by the wheel mounting studs.

11. Position knuckle and bearing assembly on hub.

12. Install Large Pilot, J-22214-8, through steering knuckle so that pilot seats on bearing, Fig. 3-66, and press knuckle assembly on hub.

13. Install inner seal on Seal Installer, J-23115, and press inner seal into steering knuckle, Fig. 3-52.

(NOTE: Webbing of Seal Installer, J-23115, may have to be undercut before tool will accept seal.)

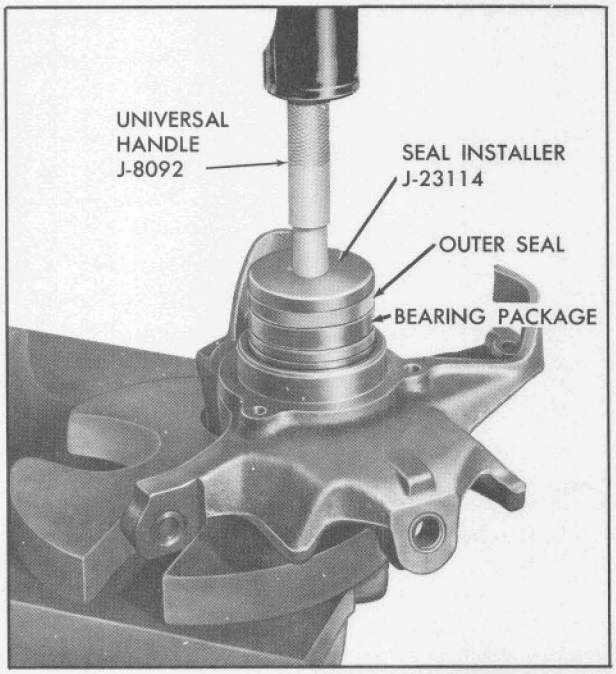


Fig. 3-65 Installing Bearing Package

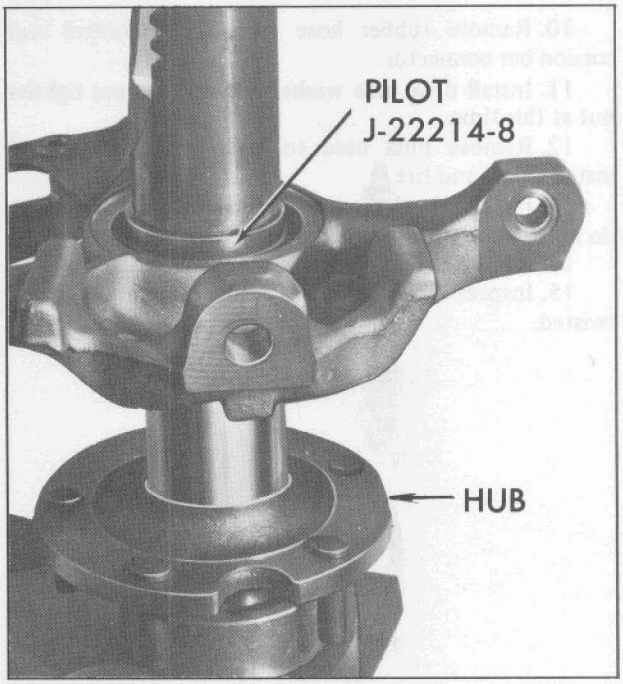


Fig. 3-66 Installing Hub in Knuckle

d. Installation

1. Guide knuckle assembly over drive axle, install lower spherical joint stud into knuckle, and attach nut. Do not tighten nut at this time.

2. Install tie-rod end stud into knuckle and attach nut. Do not tighten nut at this time.

3. Install upper spherical joint stud into knuckle and install upper spherical joint stud nut loosely.

4. Using alignment marks placed on hub and disc at time of disassembly, align disc with hub and install disc on hub.

5. Install one or two nuts on hub to prevent disc from falling or being knocked off hub.

6. Install caliper as described in Section 5, Note 12c, Steps 3 through 10 and Step 17.

(NOTE: Remove upper spherical joint nut to install brake hose clip on stud. Take care not to twist brake hose during caliper installation.)

7. Install upper spherical joint nut, tighten nut to 60 foot-pounds and install new cotter pin. Bend cotter pin tight against flats on nut. *(See CAUTION on Page 3-5.)*

CAUTION: If cotter pin cannot be installed, tighten nut to next hole and install cotter pin. Cotter pin must be crimped tight against flats on nut to prevent interference with or damage to the drive axle constant velocity joint or seal.

8. Tighten tie-rod end nut to 40 foot-pounds and install new cotter pin. *(See CAUTION on Page 3-5.)* (If pin cannot be installed, tighten nut to next hole.)

9. Tighten nut on lower spherical joint stud to 80 foot-pounds and install cotter pin. *(See CAUTION on Page 3-5.)* (If pin cannot be installed, tighten nut to next hole.)

10. Remove rubber hose from lower control arm torsion bar connector.

11. Install drive axle washer and nut. Do not tighten nut at this time.

12. Remove nuts used to hold disc on hub, and install wheel and tire.

13. Install wheel mounting nuts; turn up snug, but do not tighten nuts at this time.

14. Raise car, remove jack stands, and lower car.

15. Inspect front brake hose to make sure it is not twisted.

16. Tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*

17. Tighten drive axle nut to 150 foot-pounds and install new cotter pin. *(See CAUTION on Page 3-5.)* (If pin cannot be installed, tighten nut to next hole.)

18. Check standing height and front end alignment and adjust as required, Notes 18 and 19.

19. Install wheel disc.

GENERAL DESCRIPTION

(NOTE: The following information is applicable only to the Eldorado.)

The front wheel drive system consists of a final drive unit, right and left output shafts, and right and left drive axles.

The final drive assembly includes a spiral bevel ring and pinion gear set with a ratio of 3.07:1 and a spur bevel differential gear set. The function of the unit is similar to that of a standard differential. The pinion gear is splined directly to the transmission, and the housing is secured to the transmission by eight fasteners: six screws, and two nuts that attach to studs in the transmission. The final drive housing is secured at its forward end by a support bracket which in turn is fastened to an engine mount bracket.

A twin gasket assembly is used between the final drive housing and cover to provide a controlled vent for excess lubricant.

Torque from the final drive is transmitted to the output shafts which connect to the drive axles. The output shafts are splined to the side gears in the final drive. The longer right output shaft requires a special support brace.

The drive axles, Fig. 3-67, are flexible assemblies, consisting of an axle shaft with a ball-type constant velocity joint at the outboard end and a tri-pot constant velocity joint at the inboard end. Tri-pot joints flex not only in respect to the angle through which they operate, but also in and out. This provides a means of lengthening and shortening of the drive axles as required by the front suspension as it travels through its ride motion.

The right drive axle incorporates a torsional damper.

DIAGNOSIS

CONDITION	CAUSE	CORRECTION
Clicking noise in turns.	Excessive wear or broken outboard joint.	Inspect and replace outboard joint if necessary.
Coast to drive "clunk".	Loose inboard joint flange bolts.	Tighten to specified torque.
	Inoperative rubber damper (RH side).	Replace right shaft and damper assembly, Part No. 780 5327.
	Loose spline RH damper to shaft.	Replace right shaft and damper assembly, Part No. 780 5327.
Shudder or vibration on acceleration.	Incorrect U-joint angle.	Check front standing height and correct if necessary.
	Excessive wear on inboard joint housing.	Check for brinelling of housing bores and replace if necessary.
	Worn spider assembly.	Check for wear or free rotation of balls on spider. Replace spider assembly if necessary.
Shimmy vibration at highway speeds.	Tires out of balance or out of round.	Balance front wheels true for out of round.

SERVICE INFORMATION

The final drive unit is not serviced but is replaced as a unit, with the exception of the following parts, which are serviced separately: pinion oil seal, output shaft seal, pinion bearing housing O-ring, vent pin, seal cover gasket, and filler plug gasket.

The drive axle outer constant velocity joints can be disassembled for repacking and replacement of seals. If any other defect is found, replace the joint as an assembly. The inboard tri-pot joints can be disassembled for repacking and replacement of the spider components, seals, and housing end cover O-ring.

CAUTION: Whenever any operations call for disconnection, connection, removal, or installation of the drive axles, extreme care must be exercised to prevent damage to the seals. When performing these operations, install a short length of rubber hose on the lower control arm torsion bar connec-

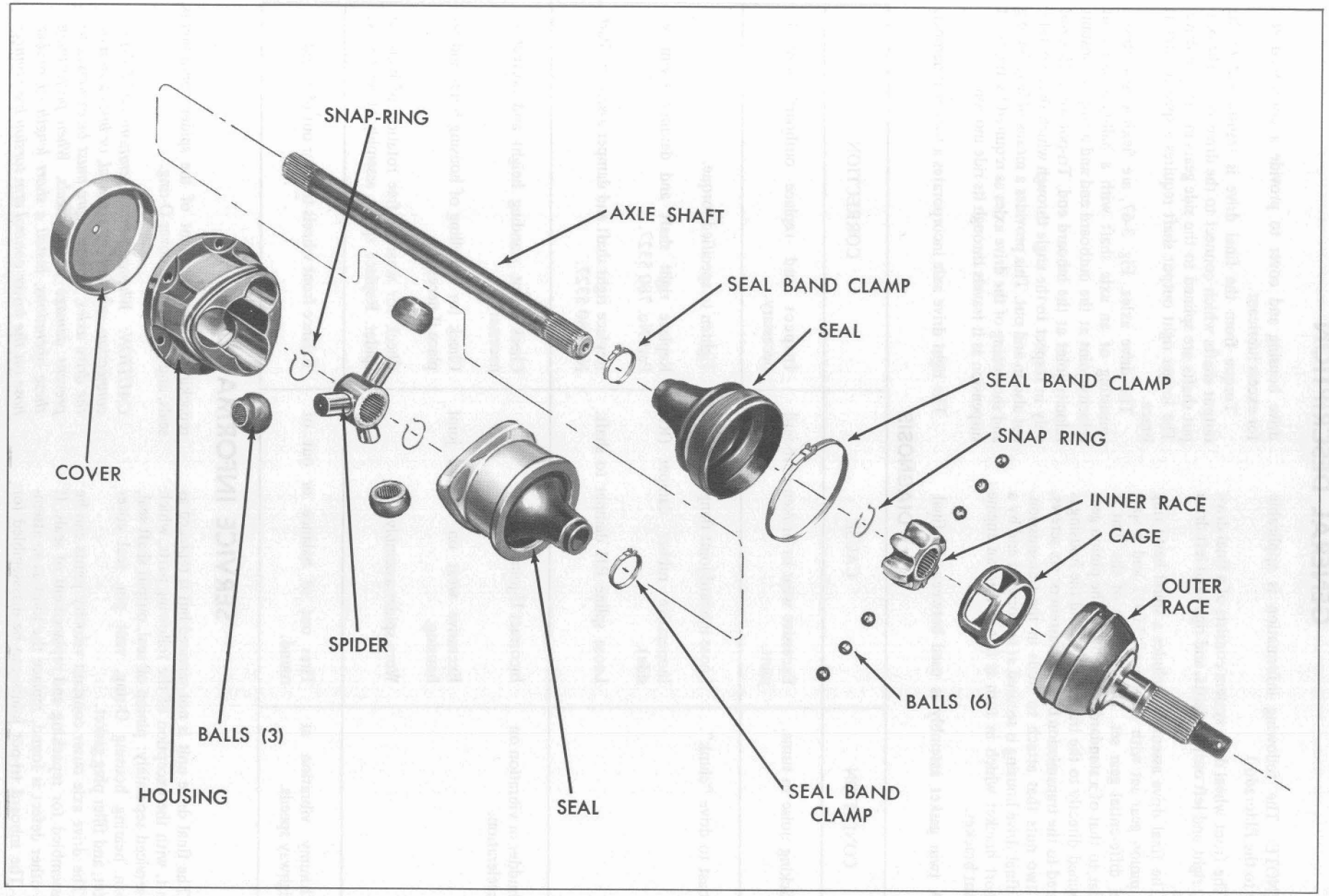


Fig. 3-67 Drive Axle Disassembled

tor to prevent inboard tri-pot joint seals from being damaged.

CAUTION: When removing or installing the right drive axle, be sure to disconnect the negative battery cable. It is possible to short out the starter motor by making contact between the wrench and the starter motor terminals.

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, torsion bars, suspension control arms, stabilizer bar, power steering pump hoses, and transmission cooler pipes.

33. Right Output Shaft and Drive Axle

a. Removal

1. Disconnect negative battery cable.
2. Remove wheel disc.

(NOTE: If drive axle is to be removed, remove cotter pin and loosen but do not remove spindle nut.)

3. Raise car so that front vehicle weight is supported at lower control arms.
4. Loosen but do not remove right front shock absorber lower mounting nut and, using a screwdriver on the mount inner sleeve, pry shock absorber along lower mounting stud until it reaches nut.

CAUTION: Do not remove shock absorber from lower mount.

5. Install a short length of rubber hose on both lower control arm torsion bar connectors, Fig. 3-49.
6. Remove six screws and lockwashers securing right drive axle to output shaft.
7. Move inboard end of drive axle rearward toward starter motor to gain access to output shaft.
8. Remove screw securing output shaft support strut to final drive housing, Fig. 3-68.
9. Remove two screws and flat washers securing right output shaft support to engine, Fig. 3-68.
10. Remove right output shaft, support, and strut as an assembly as follows: first, slide output shaft outboard to disengage splines; then move inboard end of assembly forward and downward until clear of car.

CAUTION: Take care to protect output shaft seal surface and splines from nicks or scratches.

11. If drive axle is to be removed, perform the following:

a. Using a block of wood and a hammer, strike end of drive axle to unseat axle at hub.

(NOTE: Spindle nut should be left on to retain axle but loose enough to allow unseating.)

b. Rotate axle inboard and toward front of car, guiding axle over front cross member and out from underside of car.

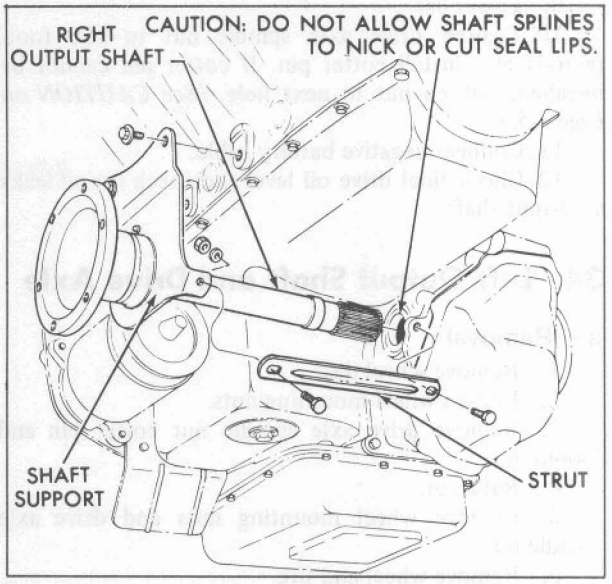


Fig. 3-68 Right Output Shaft

b. Installation

(NOTE: If drive axle was not removed, begin with Step 3.)

1. Guide drive axle into position from underside of car.

(NOTE: Guide axle up and over front cross member and engage drive axle splined end in knuckle and hub.)

2. Rotate inner end of the drive axle rearward toward starter motor.
3. Apply clean front wheel bearing grease between lips of output shaft seal, then install output shaft into final drive unit from underside of car, indexing splines of output shaft with final drive.
4. Install two bolts and washers securing output shaft support to engine. Tighten bolts to 50 foot-pounds.

(NOTE: Seat washers in old grooves in output shaft support. If a new output shaft support is being installed, perform the following procedure: when attaching the right hand output shaft support to the engine block, do not let the shaft and support assembly hang in the final drive unit. Install support bolts and washers loosely, and by moving the flange end of the shaft up and down and back and forth, find the center location. Hold the shaft in this position and then tighten bolts to 50 foot-pounds.)

5. Install support to final drive brace, securing with self-tapping screws.
6. Rotate drive axle toward front of car and into position.
7. Install six new screws and lockwashers securing drive axle to output shaft. Tighten screws to 65 foot-pounds. Have a helper apply the brakes to prevent the drive axle from turning when installing screws.
8. Install drive axle spindle nut. Do not tighten nut at this time.

9. Lower car.

10. Tighten drive axle spindle nut to 150 foot-pounds and install cotter pin. If cotter pin cannot be installed, tighten nut to next hole. *(See CAUTION on Page 3-5.)*

11. Connect negative battery cable.

12. Check final drive oil level and check for oil leaks at output shaft.

34. Left Output Shaft and Drive Axle

a. Removal

1. Remove wheel disc.
2. Loosen wheel mounting nuts.
3. Remove drive axle spindle nut cotter pin and loosen nut.
4. Raise car.
5. Remove wheel mounting nuts and drive axle spindle nut.
6. Remove wheel and tire.
7. Remove six drive axle to output shaft screws and lockwashers and discard screws and washers. Have a helper apply the brakes to prevent drive axle from rotating when removing screws.
8. Loosen shock absorber upper mount bolt.
9. Remove upper spherical joint cotter pin and nut, and remove brake hose clip from joint stud.
10. Using a hammer, strike knuckle in area of upper spherical joint. Lift up on upper arm and remove joint stud from steering knuckle.

CAUTION: Use extreme care to prevent hammer from slipping and hitting brake hose.

11. Remove brake hose bracket from frame.
12. Carefully tip disc and knuckle assembly out at upper end to extent of brake hose.

CAUTION: Wire assembly to upper control arm so that brake hose does not support the weight of the knuckle assembly.

13. Rotate inner end of drive axle toward front of car.
14. Guide drive axle out of knuckle and remove drive axle from car.
15. Remove left output shaft retaining bolt.

(NOTE: To remove bolt, install two screws in output shaft flange to prevent output shaft from rotating.)

16. Remove output shaft by pulling straight out toward side of car.

CAUTION: Use extreme care when removing output shaft to protect oil seal surface on shaft from nicks and scratches.

b. Installation

1. Apply clean wheel bearing grease between lips of final drive output shaft seal.
2. Install output shaft from underside of car.

CAUTION: Use extreme care when indexing output shaft splines with splines in final drive unit to prevent damage to the splines.

3. Install output shaft retaining bolt. Tighten bolt to 37 foot-pounds.

(NOTE: To install bolt, install two screws in output shaft flange to prevent output shaft from rotating.)

4. Guide drive axle into car and install drive axle spindle into steering knuckle.
5. Align drive axle inner joint flange with output shaft flange.
6. Install six new drive axle to output shaft screws and lockwashers. Tighten screws to 65 foot-pounds. Have helper apply brakes to prevent axle from rotating when installing screws.
7. Carefully remove wire supporting knuckle assembly, then lift up on upper control arm and install upper spherical joint stud in steering knuckle.
8. Install brake hose clip on upper spherical joint stud.
9. Install nut on upper spherical joint stud. Tighten nut to 60 foot-pounds and install cotter pin. *(See CAUTION on Page 3-5.)*
10. Install brake hose bracket on frame.

CAUTION: Be careful not to twist brake hoses or otherwise damage the brake system.

11. Tighten shock absorber upper mount nut to 75 foot-pounds.
12. Install drive axle spindle washer and nut. Do not tighten nut at this time.
13. Install wheel and wheel mounting nuts. Do not tighten nuts at this time.
14. Remove rubber hose from lower control arm torsion bar connector and lower car.
15. Tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 3-5.)*
16. Tighten drive axle spindle nut to 150 foot-pounds and install cotter pin. If cotter pin holes do not line up at this position, tighten nut further until pin can be installed. *(See CAUTION on Page 3-5.)*
17. Install wheel disc.
18. Check final drive oil level and check for leaks at output shaft.

35. Outer Constant Velocity Joint (Ball Type)

The outer constant velocity joints are replaced as an assembly and are disassembled for repacking and replacement of seals only.

a. Disassembly

1. Insert axle assembly in vise. Clamp on midportion of axle shaft.

CAUTION: Protect axle shaft to prevent jam marks from vise. If right drive axle is being worked on, use extreme caution when clamping on torsional damper.

2. Remove inner and outer seal band clamps as shown in Fig. 3-69.
3. Slide seal down axle to gain access to the constant velocity joint. Wipe excess grease from joint to permit access to the snap ring.

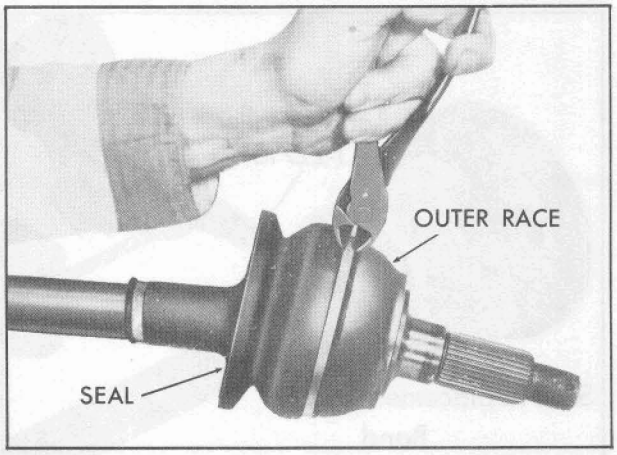


Fig. 3-69 Removing Seal Clamp Bands

4. Using Snap Ring Pliers, J-8059, spread snap ring and slide joint off axle spline as shown in Fig. 3-70.

5. Remove inner race snap ring as shown in Fig. 3-71.

6. Slide seal off axle shaft.

7. Insert joint in vise, clamping on shank. Use jaw blocks to prevent damage to joint shank.

8. Using a hammer and brass drift, tap on inner race until one ball can be removed, Fig. 3-72. Tip race in this manner to remove each ball. It may be necessary to pry last ball from cage with screwdriver.

9. Turn cage 90° as shown in Fig. 3-73 with slot in cage aligned with short land on outer race and lift cage out with inner race.

10. Turn short land of inner race 90° in line with hole in cage. Lift land on inner race up through hole in cage, then turn up and out to separate parts as shown in Fig. 3-74.

b. Cleaning and Inspection (Outer Joint)

Wash all parts thoroughly in a cleaning solvent and dry with compressed air. Inspect rubber seals for damage or wear. If seals are damaged or worn, replace with new seals.

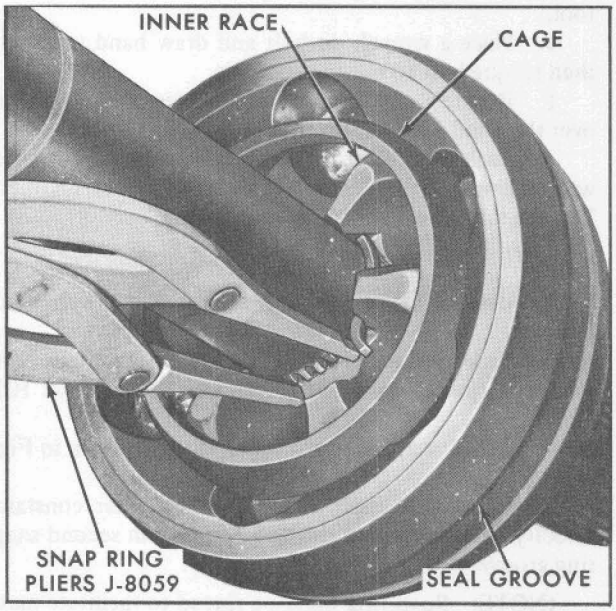


Fig. 3-70 Removing Outer Joint from Axle

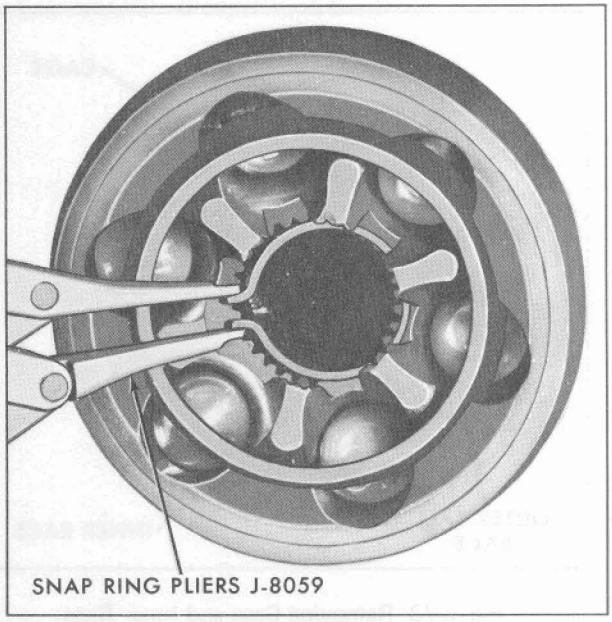


Fig. 3-71 Removing and Installing Inner Snap Ring

(NOTE: If any of the first four defects are found, the constant velocity joint assembly must be replaced as a unit.)

1. Inspect outer race for excessive wear or scoring in the ball grooves. Check housing splines and threads for any damage.

2. Inspect balls (six) for nicks, cracks, scores, or wear. Slight scuffing or nicking is considered normal.

3. Inspect cage for cracks, breaks, or excessive brinelling of the window flats.

4. Inspect inner race for excessive wear, scores, or cracks.

(NOTE: Inner and outer races may show a definite polished area where the balls travel but the CV joint need not be replaced. However, if the wear pattern is

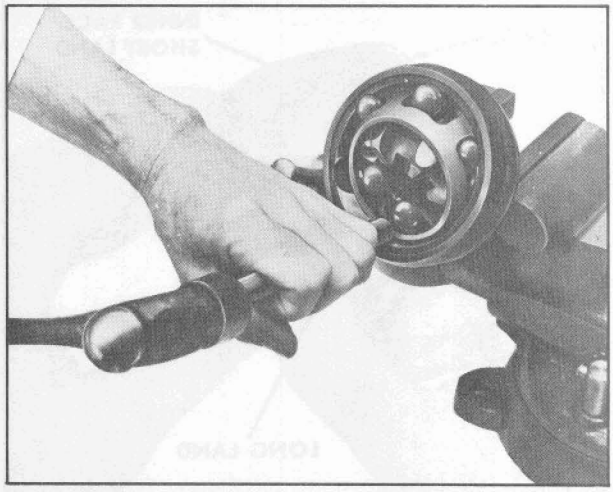


Fig. 3-72 Removing Balls from Outer Joint

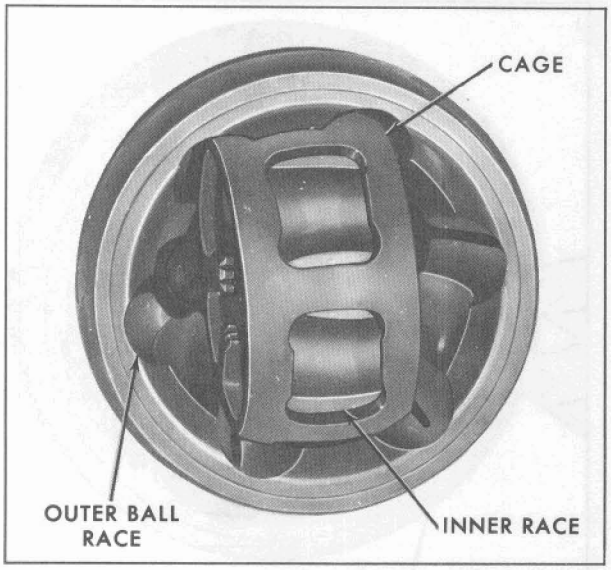


Fig. 3-73 Removing Cage and Inner Race

suspected to be the cause of a noisy or vibrating joint, replace joint.)

5. Inspect snap ring.

c. Assembly

1. Insert short land of inner race into slot in cage, and pivot to install in cage shown in Fig. 3-74.

2. Pack constant velocity joint with special drive axle joint lubricant, Part No. 105 0802.

(NOTE: One can of lubricant will service one complete drive axle joint only.)

3. Insert cage and inner race into outer race by aligning windows on cage with lands on outer race, Fig. 3-73. Pivot cage and inner race 90°.

(NOTE: Be certain that step on cage bore is positioned to inside of joint and snap ring groove on inner race is facing outside.)

4. Apply lubricant to the inner and outer race and

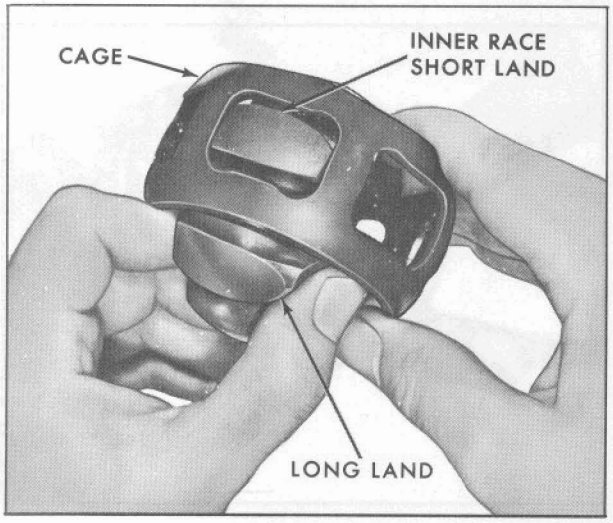


Fig. 3-74 Removing Inner Race from Cage

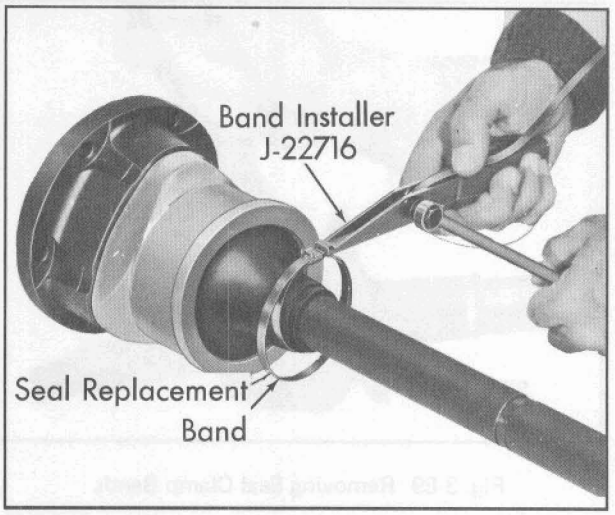


Fig. 3-75 Positioning Seal Clamp Band on Seal

insert balls into outer race one at a time until all six balls are installed. Inner race and cage will have to be tilted so that each ball can be inserted. Use of a hammer and brass drift may be helpful if a tight fit is encountered.

5. Position small end of groove on axle shaft.

When installing outer joint seal on axle shaft, position small end of seal in outer groove in axle shaft, or groove nearest end of axle shaft, Fig. 3-75, and proceed as follows:

a. Loop seal clamp band around seal end twice with strap passing through its own retainer each time a loop is completed.

b. After completion of second loop, feed extra length of strap into small end of Seal Clamp Band Installer, J-22716. Be sure to have the open side of the tool facing up.

c. Slide bolt through holes in side of tool and, at the same time, secure strap in slot in the bolt.

d. Lift end of strap up and out of the open side of tool.

e. Place a wrench on bolt and draw band up tight, then torque bolt to 6-8 foot-pounds.

f. Rotate Seal Clamp Band Installer, J-22716, back over the band retainer.

g. Back tool off just enough to permit tapping band with a hammer until it lies flat across top of retainer. Tap the tabs down until they retain strap.

CATUION: Tap lightly to avoid damaging seal.

h. Unwind the excess strap and cut it off close to retainer.

6. Pack inside of seal with approximately 1/4 pound of special drive axle joint lubricant, Part No. 105 0802.

7. Install snap ring into inner race as shown in Fig. 3-71.

8. Insert axle shaft into splines of outer constant velocity joint until snap ring secures shaft in second snap ring groove.

(NOTE: Snap ring must be spread to facilitate mating of axle shaft into splines of outer constant velocity joint.)



Fig. 3-76 Removing Seal Adapter from Joint Housing

9. Position seal in groove of outer race.

(NOTE: Mating area of seal and outer race must be free of lubricant to obtain proper sealing.)

10. Install large seal clamp band over seal and install band.

Inner Joint

a. Disassembly

1. With axle assembly lying on a bench, pry up staked areas on seal retainer and drive off housing with hammer and chisel, Fig. 3-76.

2. Grasp axle assembly with one hand and joint housing with the other and stand both vertically on bench. Carefully withdraw axle from housing, being certain not to lose balls and needles from axle.

(NOTE: It may be helpful to place a rubber band over ends of spider to retain the three balls and needle bearings. Wipe all excess grease from joint. Set housing aside.)

3. Insert axle assembly in vise. Clamp on mid-portion of axle shaft.

CAUTION: Be careful when clamping to avoid damage to axle.

4. Remove snap ring from end of axle shaft, Fig. 3-77.
5. Slide spider assembly, Fig. 3-78, from axle shaft.
6. Remove inner snap ring from axle shaft.
7. Remove small seal clamp.
8. Slide boot seal of axle shaft.
9. Remove three balls from spider, being careful not to lose any of the 53 needle bearings in each of the balls.
10. If necessary to remove tri-pot housing end cover or O-ring, proceed as follows:
    a. Secure housing in vise.
    b. Place a block of wood (approximately 2" x 2" x 8") in housing.
    c. Drive on wood block to push end cover out of housing.
    d. Remove housing O-ring and discard O-ring.

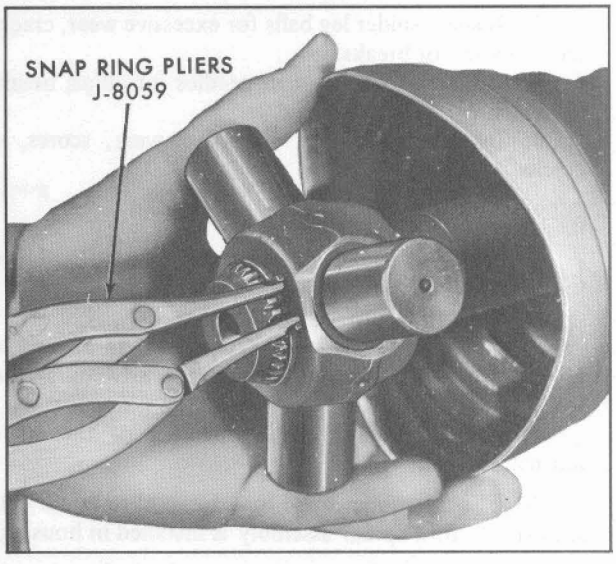


Fig. 3-77 Removing Spider Snap Ring

b. Cleaning and Inspection (Inner Joint)

Wash all parts thoroughly in a cleaning solvent and dry with compressed air. Inspect rubber seal and O-rings for damage or wear. If seal or O-rings are damaged or worn, replace with new seal or O-rings.

1. Inspect seal adapter band for bent or cracked condition.
2. Inspect tri-pot housing for excessive wear and brinelling.

(NOTE: Housing may show a definite polished area where the balls travel but joint need not be replaced. However, if this wear pattern is suspected to be the cause of noise or vibration complaint, replace joint.)

3. Inspect snap rings for distortion or damage.

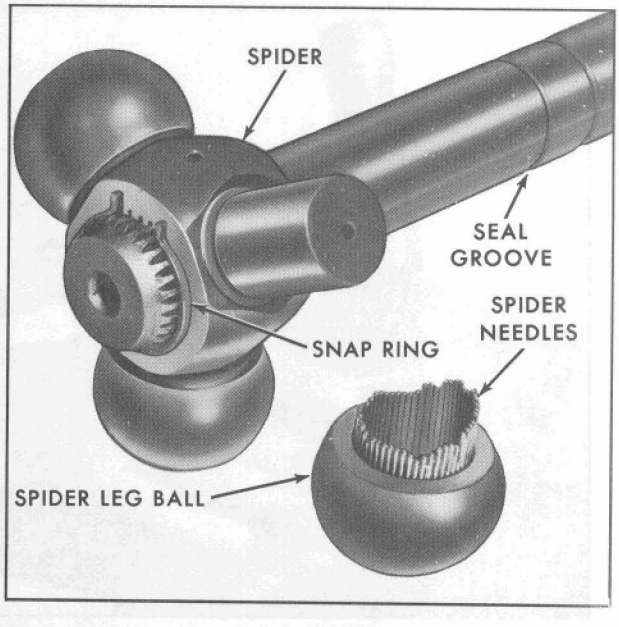


Fig. 3-78 Spider Assembly

4. Inspect spider leg balls for excessive wear, cracks, nicks, scores, or breaks.

5. Inspect spider leg ball needles for chips, breaks, or bends.

6. Inspect spider for excessive wear, scores, or cracks.

c. Assembly

1. Slide new clamp onto axle shaft to be used after seal positioning.

2. Slide seal onto axle shaft.

3. If spider needles were removed, load 53 needles into each ball, lubricating with special drive axle lubricant, Part No. 105 0802.

4. Carefully install balls on each of the spider journals.

(NOTE: A rubber band may be used to retain balls in position until spider assembly is installed in housing.)

5. Position spider assembly on axle shaft and retain with retaining ring.

6. If end cover and O-ring were removed, install new O-ring in housing, lubricate O-ring and install cover by tapping around outer edge of cover, Fig. 3-79.

7. Install O-ring in outer groove in housing.

8. Pack housing approximately one-half full with lubricant.

9. Remove rubber band, if used, from spider assembly.

10. Position spider assembly in line with housing assembly and push into housing until bottomed.

11. Fill housing with remainder of lubricant.

12. Swab inside of boot seal retainer and housing outer groove O-ring with lubricant.

CAUTION: Be careful that seal retainer is positioned so that O-ring is not cut.

13. With housing positioned as shown in Fig. 3-80, tap seal retainer on three lobes alternately with plastic hammer as shown until firmly bottomed, then stake three places into staking groove.



Fig. 3-79 Installing Tri-pot Housing End Cover



Fig. 3-80 Installing Seal Adapter on Joint Housing

14. Extend inboard joint to maximum length and position seal into furthest groove from joint in axle.

15. Install seal clamp band on small end of seal, Fig. 3-80. Proceed as follows:

a. Loop seal clamp band around seal twice with strap passing through its own retainer each time a loop is completed, Fig. 3-75.

b. After completion of second loop, feed extra length of strap into small end of Seal Clamp Band Installer, J-22716.

(NOTE: Be sure to have the open side of the tool facing up.)

c. Slide bolt through holes in side of tool and at same time secure strap in slot in the bolt.

d. Lift strap up and out of open side of tool.

e. Place a wrench on bolt and draw band up tight, then torque bolts to 6-8 foot-pounds.

f. Rotate Seal Clamp Band Installer, J-22716, back over band retainer.

g. Back tool off just enough to permit tapping band with a hammer until it lies flat across top of retainer. Tap tabs down until they retain strap.

h. Unwind excess strap and cut it off close to retainer.

37. Right Output Shaft Bearing

a. Removal

1. Remove output shaft as described in Note 33a, Steps 1 through 10.

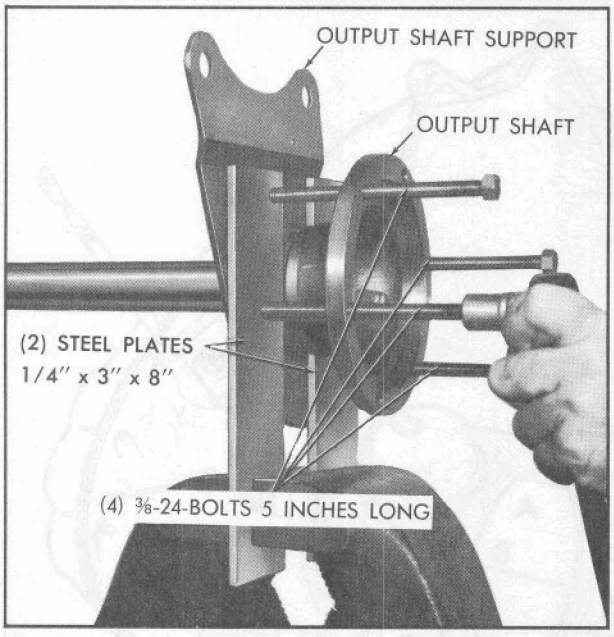


Fig. 3-81 Removing Right Output Shaft Support and Bearing

2. Remove three self-tapping screws securing output shaft bearing retainer to support.

3. Clamp output shaft in a vise as shown in Fig. 3-81.

CAUTION: Use extreme care to prevent damage to seal surface on output shaft.

4. Make two steel plates 1/4" x 3" x 8" and install in a vise as shown in Fig. 3-81.

5. Install four 3/8"-24 bolts (five inches long) on output shaft and install output shaft between steel plates in vise as shown in Fig. 3-81.

6. Remove bearing assembly by tightening bolts alternately.

b. Installation

1. Position output shaft on flange end on a work bench, Fig. 3-82.

2. Lubricate output shaft support and install over splined end of output shaft.

3. Lubricate bearing and install, using a hammer and Bearing Installer, J-22828, Fig. 3-82.

4. Lubricate exposed face of bearing and install bearing retainer. Secure bearing retainer with three self-tapping screws.

5. Using a hammer and Bearing Installer, J-22828, install slinger as shown in Fig. 3-83.

6. Install output shaft as described in Note 33b, beginning with Step 3.

38. Output Shaft Seal Replacement

a. Removal

1. To replace right output shaft seal, remove right output shaft as described in Note 33a. Steps 1 through 10. Then remove seal from final drive unit with a pry bar and discard seal.

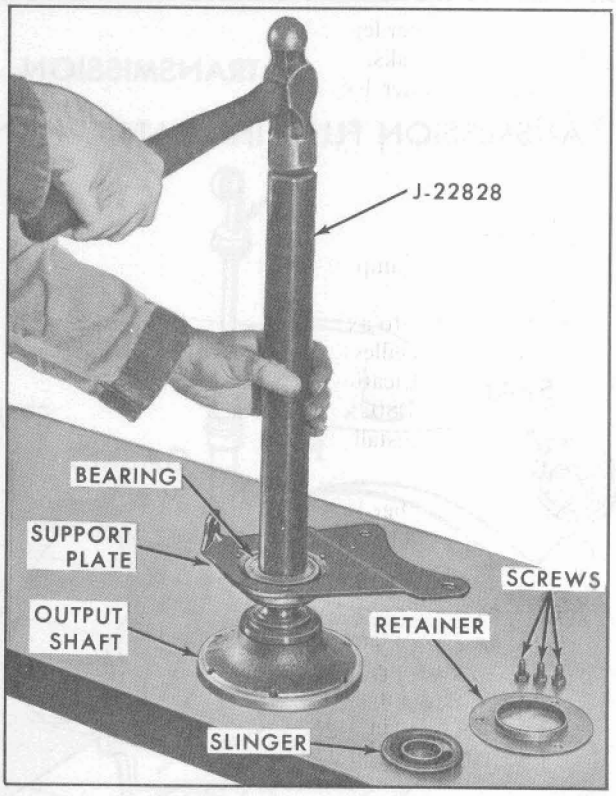


Fig. 3-82 Installing Right Output Shaft Support and Bearing

CAUTION: When removing seal, use extreme care to prevent damaging seal surface in final drive unit.

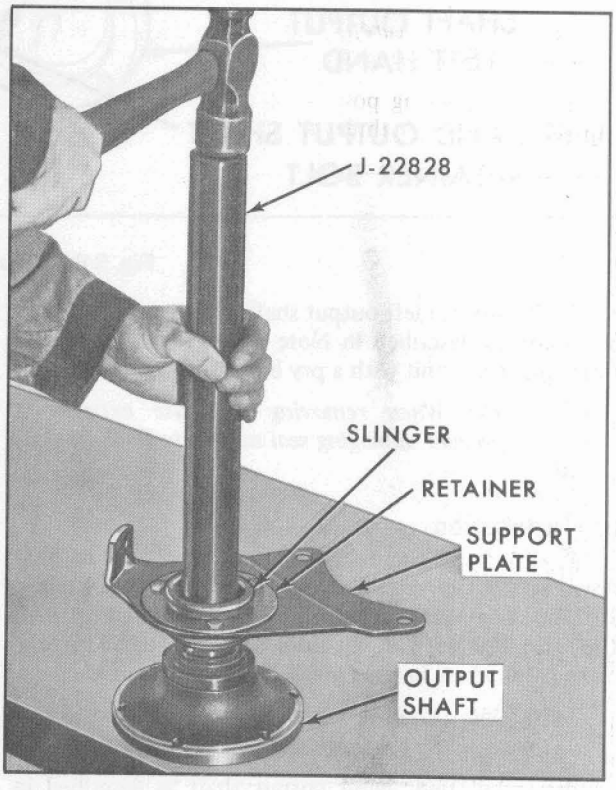


Fig. 3-83 Installing Right Output Shaft Support Slinger

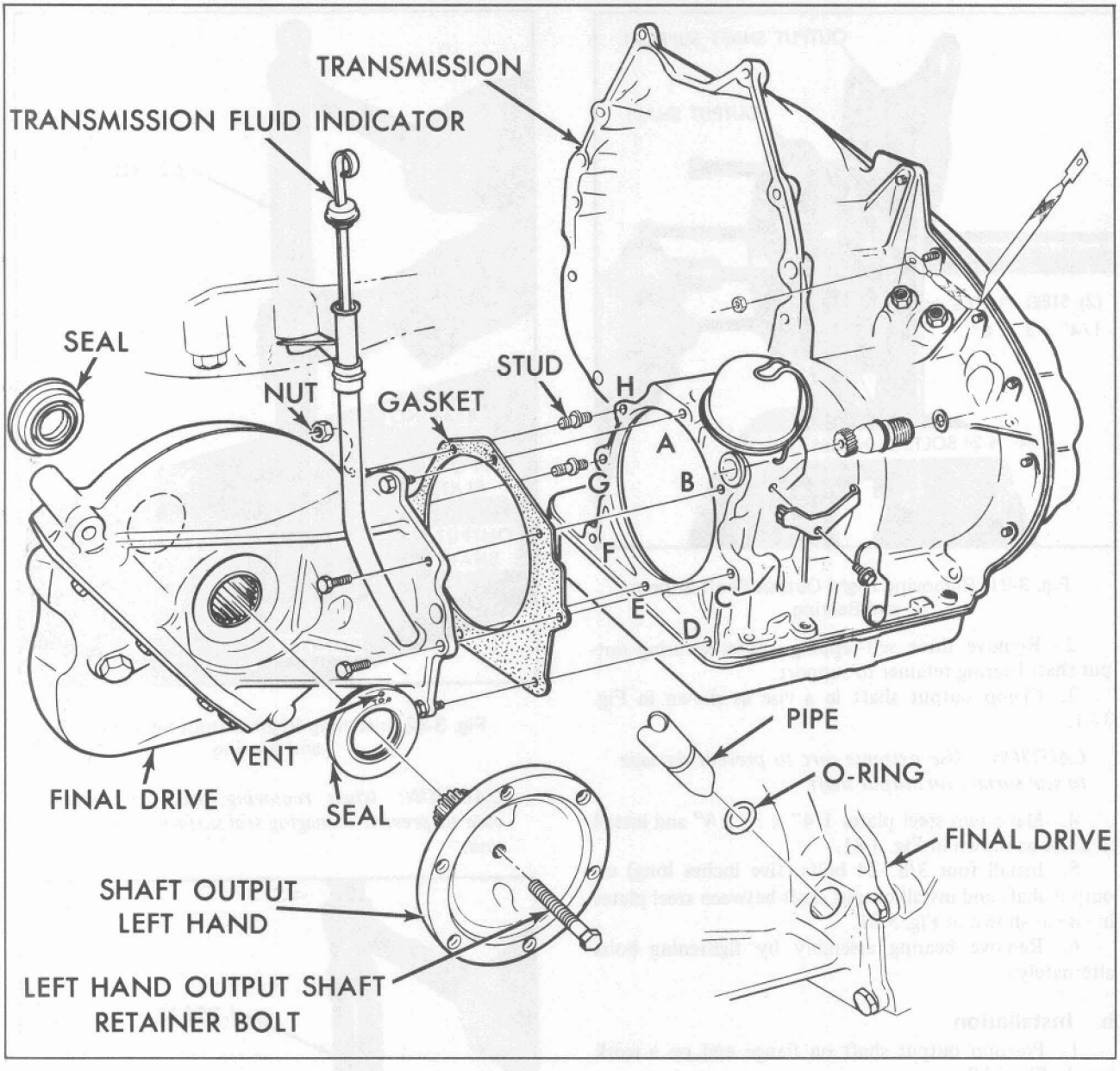


Fig. 3-84 Final Drive Attachment

2. To replace left output shaft seal, remove left output shaft as described in Note 34a. Then remove seal from final drive unit with a pry bar and discard seal.

CAUTION: When removing seal, use extreme care to prevent damaging seal surface in final drive unit.

b. Installation

1. To install right hand output shaft seal in final drive, attach Universal Handle, J-8092, to Seal Installer, J-22760. Then place seal in final drive unit and drive on Universal Handle, J-8092, until seal is installed. Apply clean front wheel bearing grease between lips of seal.

CAUTION: Rotate tools to maintain proper alignment when installing seal.

2. Install right hand output shaft as described in Note 34b, beginning with Step 3.

3. To install left hand output shaft seal in final drive, attach Universal Handle, J-8092, to Seal Installer, J-22199. Then place seal in final drive unit and drive on Universal Handle, J-8092, until seal is installed.

(NOTE: The left hand output shaft seal contains a hole for venting the final drive unit. The top of the seal is identified by the word "Top" and must be installed with the word "Top" positioned up so that vent will be in proper position.)

4. Install left hand output shaft as described in Note 34b.

39. Final Drive

a. Removal

1. Raise hood and disconnect negative battery cable.

2. Remove bolt securing transmission filler tube bracket to final drive bracket and remove transmission filler tube.

3. Remove screws "A" and "B" and nut "H" securing upper part of final drive housing to transmission housing, Fig. 3-84.

(NOTE: The use of a box end wrench with a crescent-shaped handle, such as a starter and manifold wrench, will facilitate removal of nut "H".)

4. Remove self-tapping screw securing transmission cooler lines and clip to final drive support bracket, Fig. 3-85, and slide clip out of way.

5. Remove locknut, washer, and long bolt securing final drive support brace to engine mount bracket, Fig. 3-85. (Use a second wrench to hold locknut in place while turning bolt.)

6. Remove screw, lockwasher, and flat washer securing final drive brace to engine mount bracket, Fig. 3-85.

7. Remove right output shaft, following Note 33a, Steps 3 through 10.

8. WARNING: THE SHOCK ABSORBERS ACT AS REBOUND STOPS ON THE ELDORADO FRONT SUSPENSION. BEFORE PERFORMING THE FOLLOWING STEP, BE CERTAIN THAT RIGHT SHOCK ABSORBER LOWER SLEEVE CANNOT BE DISLODGED FROM MOUNTING STUD.

Place jack stands under front frame side rails. Lower hoist and move hoist equipment away from work area.

9. Place a drain pan under final drive cover. Loosen ten final drive cover screws and pull cover away from housing. Allow lubricant to drain while performing next four steps.

10. Remove six screws securing left drive axle to output shaft. Compress drive axle inner constant velocity joint and secure in this position to permit clearance for removal of final drive unit with left output shaft installed.

11. Remove bolt, washer, and nut securing left tie strut to frame cross member, loosen bolt securing strut

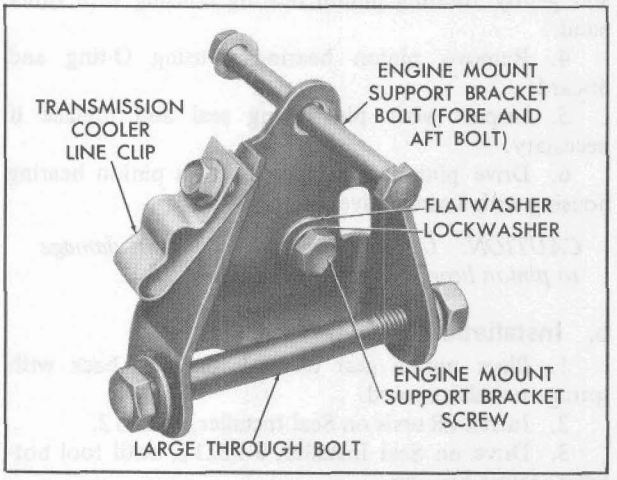


Fig. 3-85 Final Drive Support Bracket and all Fasteners

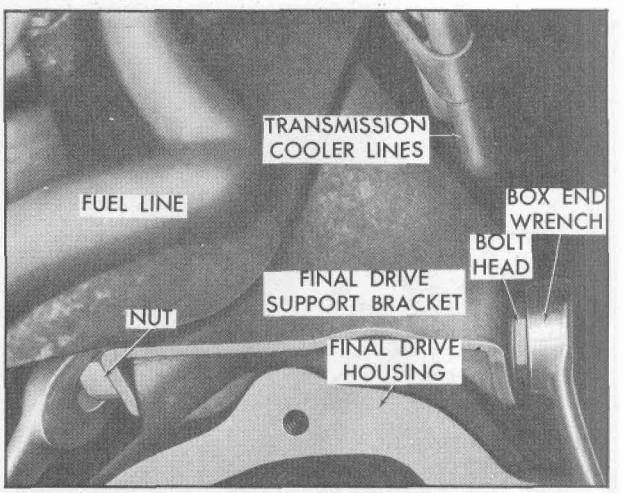


Fig. 3-86 Removing and Installing Large Through Bolt

to side rail, and rotate strut outboard until clear of final drive area.

12. Remove large through bolt, nut, and washers securing final drive support bracket to final drive. (Use a second wrench to hold nut stationary while turning bolt, Figs. 3-85 and 3-86)

13. Using a hammer and brass drift, remove final drive support bracket by driving upward and toward transmission cooler lines.

14. Remove ten final drive cover screws and remove cover and cover gaskets.

15. The final drive assembly should be removed and installed with a transmission lift and a special adapter. Adapters are available commercially through lift equipment manufacturers. One such mechanism is shown in Fig. 3-87. All adapters to this purpose feature pivot points to provide a safe means of rotating the unit during lifting and lowering. Consult the instructions and recommendations of the manufacturer.

16. WARNING: BE ABSOLUTELY CERTAIN THAT LIFT EQUIPMENT INDEPENDENTLY SUPPORTS AND HOLDS FINAL DRIVE UNIT BEFORE PERFORMING THIS STEP.

Place a drain pan under transmission and remove screws "C", "D", "E", and "F" and nut "G", Fig. 3-84.

17. Disengage final drive splines from transmission, Fig. 3-87, and allow unit to drain.

18. Remove final drive unit from underside of car by sliding unit toward front of car, permitting ring gear to rotate over steering linkage, and lowering housing from car.

19. Remove and discard final drive to transmission gasket.

b. Installation

1. Apply transmission fluid to transmission side of new gasket and place gasket on studs.

2. Attach final drive unit securely to transmission jack adapter. Lift unit to on-car position, aligning unit with two studs and aligning final drive and transmission splines, Fig. 3-87.

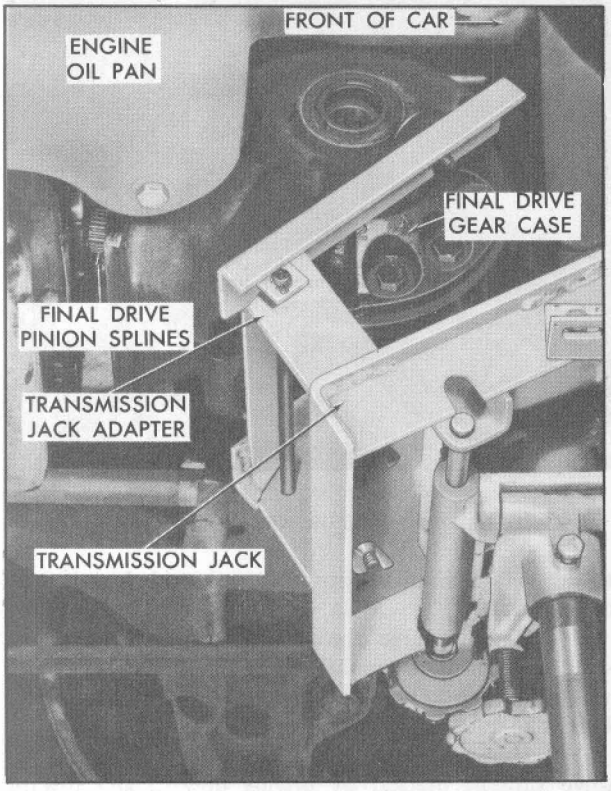


Fig. 3-87 Removing and Installing Final Drive

(NOTE: If splines do not line up, rotate left output shaft until splines can be engaged. Do not allow gasket to become mispositioned.)

3. Insert final drive support bracket as near as possible to proper installed position.

4. Insert large through bolt, nut, and washers and tighten with fingers, Fig. 3-85. Insert long bolt, washer, and locknut securing final drive support bracket to engine mount support and tighten with fingers. (If this "fore and aft" bolt cannot be installed, perform step 5; then insert bolt and proceed to step 6.)

5. Install screws "C", "D", "E", and "F" and nut "G"; tighten to 25 foot-pounds, Fig. 3-84.

6. Tighten large through bolt to 70 foot-pounds. (This torque is to be applied to head of bolt while nut is held, Fig. 3-86)

7. Remove transmission jack and adapter assembly from final drive housing and remove assembly from work area.

8. Install final drive cover and new cover gaskets, tightening ten screws to 30 foot-pounds.

(NOTE: Two gaskets are used at the final drive cover to provide a vent for the unit. Thin, dark gray gasket must be installed next to housing, with slotted, light gray gasket on top–next to cover–for vent to be effective.)

9. Position left drive axle on output shaft and fasten with six screws, tightening to 65 foot-pounds.

(NOTE: Have a helper apply brakes to prevent axle from turning while tightening screws.

10. Remove rubber hose previously installed on left torsion bar connector.

11. Install left tie strut on frame cross member, securing with bolt, nut, and washer. Tighten tie strut fastener at frame side rail.

12. Install right output shaft, support, and strut as an assembly, employing technique described in Note 33b, Steps 3 through 8.

13. Fill final drive unit with lubricant until within 1/2" of filler hole.

14. Lower car.

15. Tighten long bolt and locknut securing final drive support bracket to engine mount support to 20 foot-pounds, Fig. 3-85. (This torque is to be applied to locknut while holding bolt stationary.)

16. Install screws "A" and "B" and nut "H" securing upper part of final drive housing to transmission. Tighten to 25 foot-pounds, Fig. 3-84.

17. Install a new O-ring on transmission filler tube, Fig. 3-84.

18. Remove plug and install transmission filler tube, securing to exhaust manifold.

19. Install small screw, washer, and lockwasher securing final drive support bracket to engine mount support bracket, Fig. 3-85.

20. Slide transmission cooler line clip into place and secure clip to final drive support bracket with one screw, Fig. 3-85, tightening to 8 foot-pounds.

21. Connect negative battery cable.

22. Check engine oil level, start engine, and check transmission fluid level. Add fluid as required.

23. Check output shaft seals, final drive to transmission connection, and final drive cover for oil leaks.

40. Pinion Bearing Oil Seal Replacement

a. Removal

1. Remove final drive unit from car as described in Note 39a.

2. Working on bench, remove six pinion bearing housing to final drive case bolts.

3. Remove pinion bearing housing by applying a steady pull on splined end of pinion gear with one hand and gently rotating pinion bearing housing with other hand.

4. Remove pinion bearing housing O-ring and discard.

5. Inspect vent pin O-ring seal and replace if necessary.

6. Drive pinion gear oil seals from pinion bearing housing with a screwdriver.

CAUTION: Use extreme care to prevent damage to pinion bearing housing oil seal surface.

b. Installation

1. Place pinion gear oil seals back to back with spring on seals exposed.

2. Install oil seals on Seal Installer, J-22212.

3. Drive on Seal Installer, J-22212, until tool bottoms against housing.

4. Install a new pinion bearing O-ring in final drive case.

5. Install pinion gear in final drive case.
6. Install Seal Protector, J-22236, over splined end of pinion gear.
7. Install pinion bearing housing over pinion gear. Gently rotate pinion bearing housing until properly seated in final drive case.
8. Install six pinion bearing housing to final drive case bolts. Tighten bolts to 35 foot-pounds.
9. Remove Seal Protector, J-22236.
10. Install final drive unit in car as described in Note 39b.

TORQUE SPECIFICATIONS (693 ONLY)

Material No.	Application	Size	Foot-Pounds
286-M	Drive Axle Nut	1"-20	150*
SAE 1020-1022	Stabilizer Link Bolt	5/16-18	13
GM 6010-M	Stabilizer Bracket to Frame	5/16-18	35
280-M	Torsion Bar Crossmember Bolt	5/16-18	12
301-M	Shock Absorber (upper)	9/16-12	75
301-M	Shock Absorber (lower)	9/16-12	75
300-M	Lower Control Arm Bushing Bolts	1/2-13	80*
300-M	Upper Control Arm Bushing Bolts	1/2-20	95*
301-M	Lower Spherical Joint Nut	9/16-18	80*
301-M	Upper Spherical Joint Nut	9/16-18	60*
286-M	Tie-Rod to Knuckle	1/2-20	40*
300-M	Inner Constant Velocity Joint to Ouput Shaft	3/8-24	65
275-M	Output Shaft Support to Engine Block	7/16-14	50
GM 6010-M	Output Shaft Support to Brace	5/16-18	12
GM 6010-M	Output Shaft Support Brace to Final Drive	5/16-18	12
300-M	Left Hand Output Shaft Retainer Bolt	3/8-24	40
280-M	Bearing Retainer	3/8-16	35
301-M	Nut - Upper Control Arm Cam to Frame	1/2-20	95*
Special	Final Drive Cover Screws	5/16-18	30

(NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings, and steel classifications.)

**CAUTION: These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

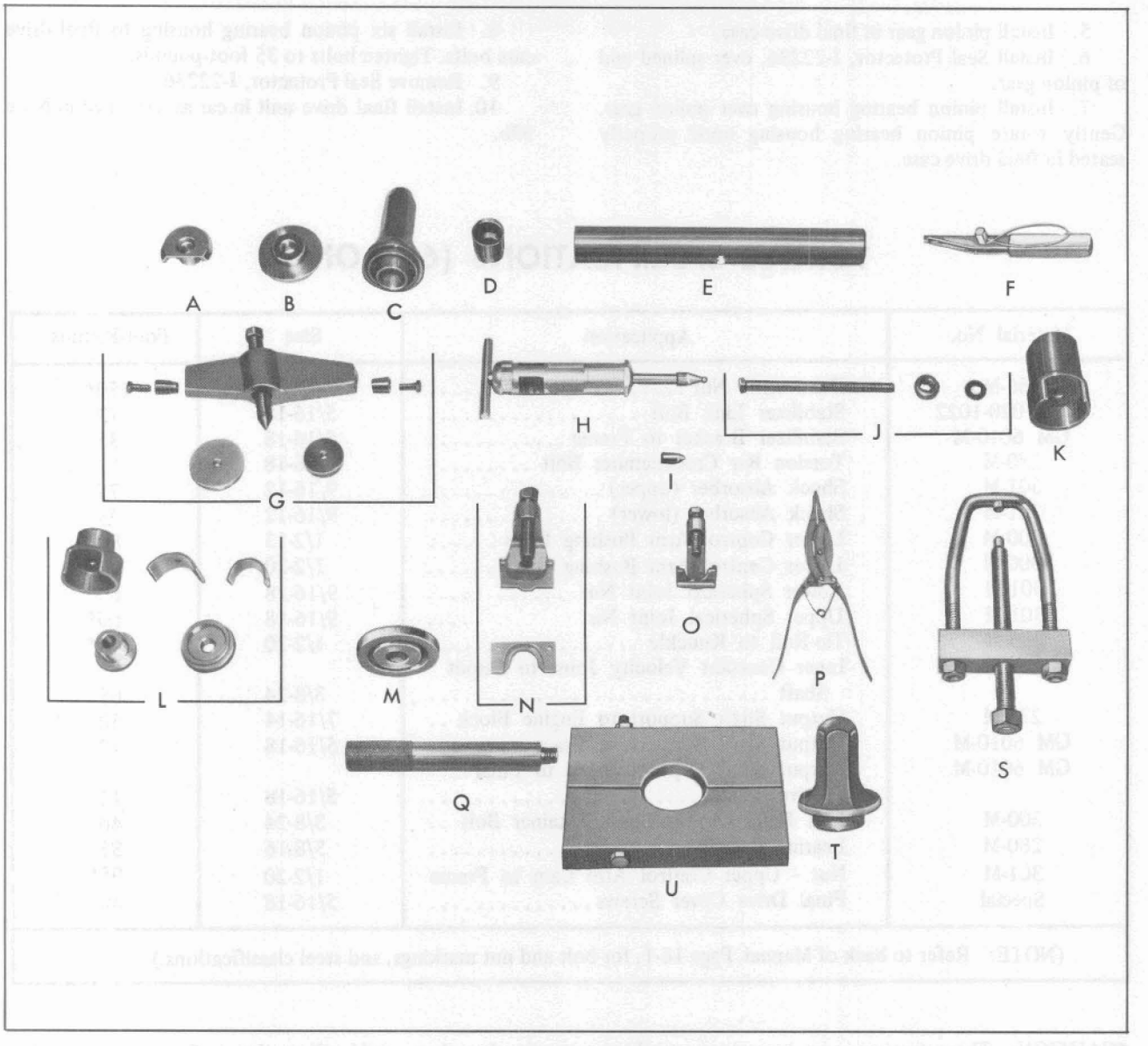
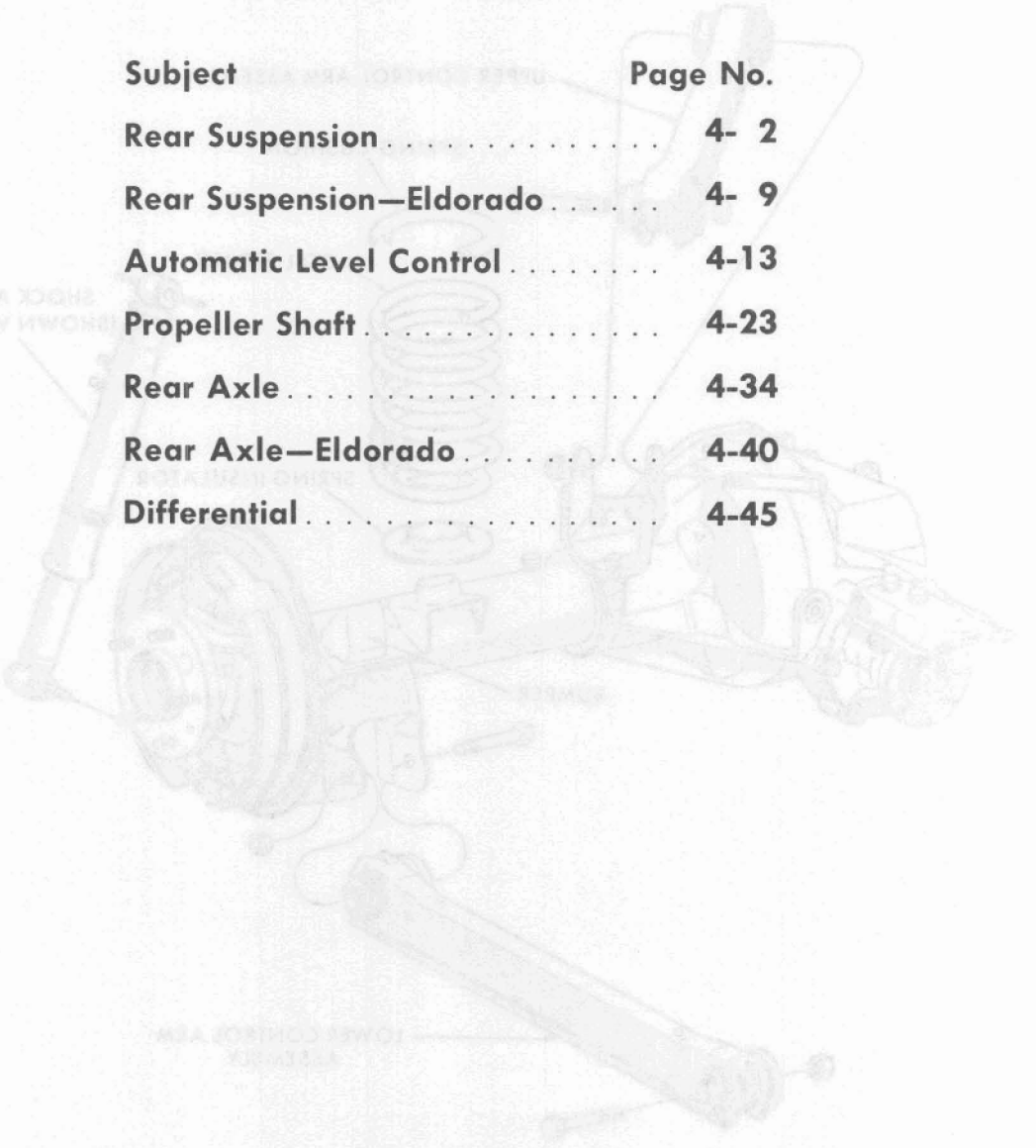


Fig. 3-88 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-22760	Right Output Shaft Seal Installer	L	J-22222	Bushing Remover and Installer Set
B	J-22199	Left Output Shaft Seal Installer	M	J-23114	Front Knuckle Outer Seal Installer
C	J-22212	Pinion Oil Seal Installer	N	J-22292	Linkage Puller
D	J-22236	Pinion Oil Seal Protector	O	J-21930	Tie Rod End Puller
E	J-22828	Output Shaft Bearing Installer	P	J-8059	Snap Ring Pliers
			Q	J-8092	Universal Handle
F	J-22716	Band Installer	S	J-22517	Torsion Bar Remover and Installer
G	J-22214	Knuckle and Bearing Remover	T	J-23115	Front Knuckle Inner Seal Installer
H	J-9280	Lubrication Gun			
I	J-9280-5	Adapter Tip	U	J-23997	Bearing Remover Press Plate
J	J-21474-3	Screw Assembly			
K	J-21474-5	Bushing Remover and Installer			

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GENERAL DESCRIPTION

A four link rear suspension system, consisting of two upper and two lower control arms, steel coil springs, and shock absorbers, Fig. 4-1, is used on all conventional drive 1972 cars except the Commercial Chassis. The heavier Commercial Chassis uses semi-elliptical multiple leaf rear springs.

The rear steel coil springs are placed on brackets on the rear axle housing at the lower ends, and the upper ends are seated in the frame cross member, Fig. 4-1. With this design there are no spring loads acting directly on the suspension bushings. This provides good bushing isolation qualities. Spring insulators are used at both top and bottom ends of the rear chassis springs to minimize noise.

Two upper control arms are attached at their rear ends to inboard brackets on the rear axle housing and at their front ends to brackets on the rear suspension cross member. Two lower control arms are attached at their rear ends to outboard brackets on the rear axle housing and on their front ends to brackets on the frame side rails. The angles of the upper control arms from the center of the axle outward, and of the lower control arms from the ends of the axle inward provide good lateral stability.

The rear shock absorbers are mounted at their upper ends in frame brackets to the rear of the axle center line. The lower ends are attached to mounting brackets on the axle housing.

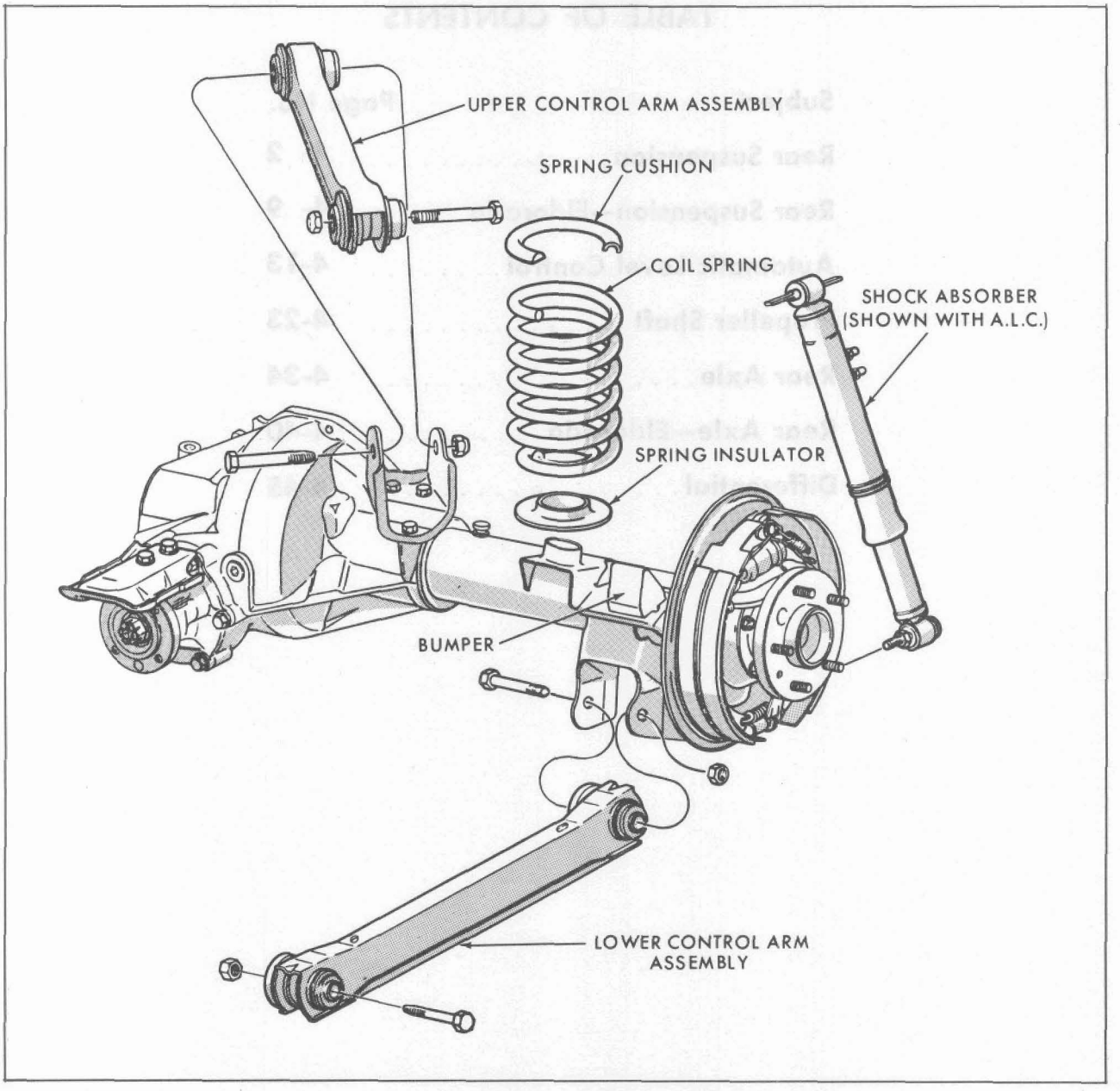


Fig. 4-1 Rear Suspension Disassembled

On cars equipped with Automatic Level Control, superlift shock absorbers are used. These shock absorbers provide up to 600 pounds additional load carrying capacity. The valving of these units is different from that of standard rear shock absorbers for optimum ride benefit.

Rear Suspension System (Commercial Chassis Only)

The rear springs are of the semi-elliptical multiple leaf type. They have seven leaves, 2-1/2 inches wide, with zinc inner liners between the first four leaves to provide correct interleaf friction and prevent corrosion. Tip liners are provided at the spring end for noise isolation and to further reduce friction. The spring eyes are cushioned at each end by rubber bushings and at the spring seats on the axle housing by rubber insulating pads.

Direct acting type rear shock absorbers are connected at the bottom to the rear spring U-bolt plates and at the top to brackets welded to the rear suspension frame cross member. Both the upper and lower mounts are of the bayonet type. This type rear shock absorber mounting provides minimum transverse roll due to the sea-leg angle in their installed positions, along with dampening of road shocks. Shock absorbers on the Commercial Chassis employ a unique valving to meet the requirements of this heavier vehicle.

Optional superlift shock absorbers are available when extra load carrying capacity is needed (300 pounds per superlift, or 600 pounds total). Pressurized air for the system is fed manually at a valve in the trunk compartment. Larger diameter grommets and retainers are used with this installation.

(Service information pertaining to the rear suspension system on the Eldorado is covered at the back of this section beginning on Page 4-9.)

SERVICE INFORMATION—EXCEPT ELDORADO

CAUTION: When raising rear of car, support vehicle weight at frame or axle or both. Never use control arms as contact points for hoist or jack stands.

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, and suspension control arms.

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology *"See CAUTION on Page 4-3"*.

CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

1. Checking Rear Standing Height

Before checking standing (spring) height, make sure that trunk is empty except for spare tire and jack and that there is a full tank of gasoline, as all specifications are based on this observed weight. If car is equipped with Automatic Level Control, deflate system using service valve, then disconnect air line from superlift port on control valve. Deflation of the system is necessary when determining the standing height on the basis of springs alone. When checking standing height to determine the proper functioning and adjustment of the Automatic Level Height Control Valve, the system must be connected and the reservoir charged with 100-140 psi. Normalize position of springs by bouncing bumper up and down, gradually reducing force applied, to permit car to assume its normal position.

a. Rear Springs

Measure distance from frame to axle, Fig. 4-2. Rear standing heights should be equal within 1/2 inch from side to side. If heights are unequal, spring that checks below specifications must be replaced. See page 4-7 for specifications for each series.

b. Ride Complaints

In case of hard riding, the first items to investigate are tire pressures, standing heights, and shock absorbers.

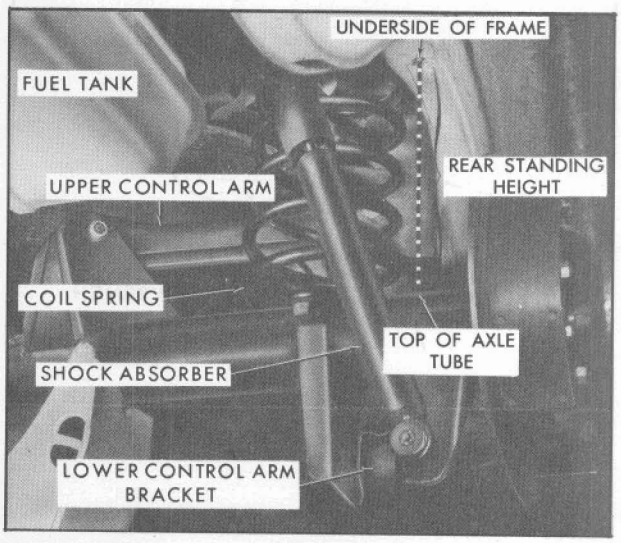


Fig. 4-2 Measuring Rear Standing Height

If these are correct, the amount of friction in the rear suspension system should be checked.

The procedure for checking excessive friction in the rear suspension is as follows:

1. Disconnect rear shock absorbers.
2. With aid of a helper, lift up on the rear bumper and raise car as high as possible. Slowly release the bumper and allow the car to assume normal standing height. Measure distance from floor to center of bumper. Then push down on bumper, release slowly, and allow car to assume normal standing height. Measure distance from floor to center of bumper.
3. The difference between the two measurements should be less than 1/2 inch. If the difference exceeds the limit, inspect the upper and lower control arms for damaged or worn parts.

2. Rear Shock Absorbers

CAUTION: Be careful not to damage brake pipes or hoses throughout procedure.

a. Removal

1. Raise car so that both frame and axle are supported.
2. If car is equipped with Automatic Level Control, remove the air line fittings at shock absorbers.

WARNING: THE SHOCK ABSORBERS ACT AS REBOUND STOPS FOR THE REAR SUSPENSION. UNDER NO CIRCUMSTANCES SHOULD REAR END OF CAR EVER BE RAISED SO THAT REAR SUSPENSION IS IN REBOUND POSITION WHILE DISCONNECTING SHOCK ABSORBER UNLESS BOTH REAR AXLE AND FRAME ARE SUPPORTED.

3. Remove shock absorber upper retaining bolts and nuts. It will be necessary to fashion a simple tool for this operation. Bend a 1/2 inch box end wrench to a 45° angle at a point one inch from the center of the box end diameter, Fig. 4-3. Use this to hold each upper mounting nut at rear frame kick-up while removing mounting bolts.

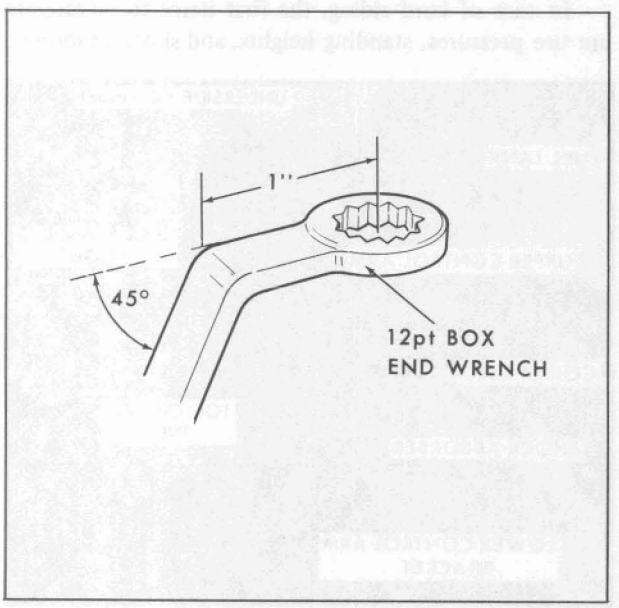


Fig. 4-3 Rear Shock Absorber Wrench

4. Remove shock absorber lower retaining nut. It will be necessary to hold stem next to grommet to keep stem from turning, while removing nut with second wrench.
5. Remove shock absorber from its mounts.

b. Installation

1. Guide upper shock absorber stem into mount.
2. Install upper retaining nuts and bolts. Use special wrench used in Step 3a to hold nut while tightening bolt with a second wrench, tightening to 12 foot-pounds.
3. Guide shock absorber lower stem into mounting bracket and install retaining nut, tightening to 50 foot-pounds.
4. If car is equipped with Automatic Level Control, perform the following steps:

a. Install air line fittings at shock absorbers, tightening tube nuts to 30-40 inch pounds.

b. Inflate reservoir through service valve to 140 psi (or maximum pressure available) through compressor service valve.

c. Disconnect overtravel lever at axle bracket and push arm up, allowing air to enter superlift.

d. Return overtravel lever to normal position and reconnect arm to axle bracket.

5. Lower car.
6. If car is equipped with Automatic Level Control, check system for proper operation as in Note 13.

3. Checking Rear Shock Absorbers

a. On Car Checks

1. Raise car on hoist.
2. Check for correct mounting of shock absorbers. If properly mounted, continue with next step.
3. Disconnect lower shock mount. Extend shock absorber and check to see if piston rod and seal (top of shock) cover is wet with a fresh film of oil. If oil is detected on rear shock absorber, remove the unit for bench check. (This check cannot be made on Automatic Level Control shock absorbers.)
4. If no oil is detected, pump shock absorber up and down by hand as fast as possible. If a skip is felt at end of stroke, remove shock absorber for bench check.
5. As another check, completely extend shock absorber and pull hard. If spring tension is felt, shock absorber should be replaced.

(IMPORTANT: Pumping shock absorber by hand will not fully determine whether a shock absorber is good or bad. The best test method is to compare the questionable shock absorber with its mate on opposite side of car; that is, a front with the other front, and rear with the other rear. If both shocks feel the same, it is unlikely that a shock absorber replacement is necessary. Bad shocks, as detected by this test, will affect ride motion only.)

b. On Bench Checks (Standard Shock Absorbers)

1. When performing a bench check for any suspected shock absorber, clamp shock absorber upside down in a vise.

(NOTE: Cadillac standard shock absorbers can be turned upside down because all internal vapor (inert gas instead of air) is contained in a pliacell envelope which prevents aeration of oil and prevents lag.)

2. Pump shock absorber by hand at various rates of speed to find if shock absorber is defective. If a skip is felt at full extension when the shock is inverted, this is normal. A skip on reversal of direction in mid-travel indicates a ruptured pliacell envelope. If smooth resistance is felt throughout length of the stroke, however, the shock absorber need not be replaced. A faint hiss ("orifice swish") is considered normal, but a gurgling noise denotes air bubbles in the fluid, and the shock absorber should be replaced.

c. On Bench Checks (Automatic Level Control Shock Absorbers)

1. Clamp lower mounting ring in vise in vertical position.
2. Extend and collapse shock completely several times to discharge air out of the working chamber.
3. Pump unit by hand at different rates of speed. Smooth resistance should be felt throughout the length of the stroke. Since the shock absorber is normally pressurized, the sound of air bubbles or a gurgling noise is normal.

4. Rear Springs

a. Removal

1. Raise car so that both rear axle and frame are supported.
2. If car is equipped with Automatic Level Control, disconnect link at overtravel lever by removing attaching nut. Position overtravel lever in center position.

3. WARNING: THE SHOCK ABSORBERS ACT AS REBOUND STOPS ON THE REAR SUSPENSION SYSTEM. DO NOT PERFORM THIS STEP UNLESS BOTH AXLE AND FRAME ARE FIRMLY SUPPORTED.

Remove both shock absorber lower retaining nuts and stems from mounts. It will be necessary to hold the stem next to the rubber grommet with one wrench to prevent the stem from turning, while removing retaining nut with a second wrench.

4. Place jack stand under pinion retainer to relieve tension on control arm bolts and remove bolts and nuts securing upper control arms to axle brackets.
5. Remove four screws and lockwashers securing propeller shaft rear flange to pinion flange and support propeller shaft with wire or chain, Fig. 4-25.
6. Remove jack stand from under pinion retainer.

7. WARNING: IF AXLE IS ALLOWED TO WIND UP AS IT IS LOWERED, SPRINGS MAY SNAP FROM THEIR SEATS. USE EXTREME CAUTION TO PREVENT WIND-UP CONDITION.

Lower axle slowly until brake hose loses almost all slack. Compress springs by hand if necessary to lift off seats, and remove springs from car.

CAUTION: Under no circumstances is the axle to be lowered to the point at which brake hoses become taut.

8. Inspect upper and lower spring insulators and replace if required.

b. Installation

1. Position lower rubber insulator on rear axle housing mount.
2. Tape upper rubber insulator to top of spring and position spring so that end of top of spring is properly aligned with recess in upper seat of frame tower. Spring position should be within limits shown in Fig. 4-4.
3. Seat bottom of spring on lower rubber insulator.
4. Raise rear axle on hoist and check spring position.
5. Install lower shock absorber stems in mounts.
6. Install one nut at each mount. Torque nuts to 50 foot-pounds.
7. Position rear upper control arms in axle brackets and secure each with one bolt and nut. Do not torque nuts at this time.
8. Raise rear axle to on-car position.
9. On cars equipped with Automatic Level Control, perform the following steps:

a. Install air line fittings at shock absorbers, tightening tube nuts to 30-40 inch-pounds.

b. Inflate reservoir to 140 psi (or maximum pressure available) through compressor service valve.

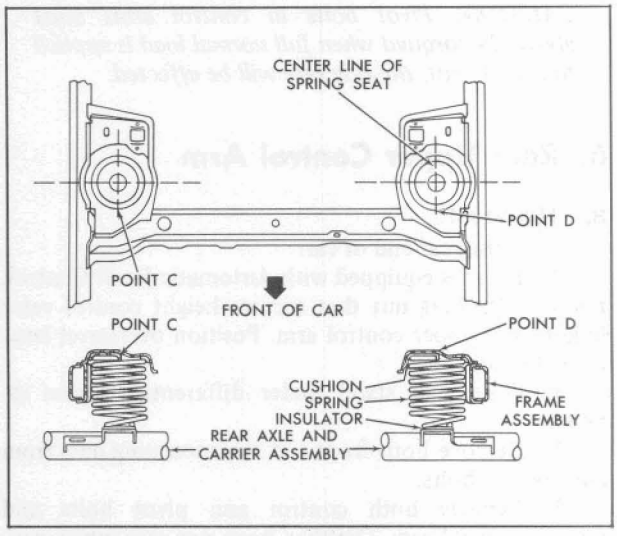


Fig. 4-4 Coil Spring Indexing

c. Lift overtravel lever allowing air to enter shock absorbers.

d. Release overtravel lever and secure to axle with one nut.

10. Secure propeller shaft rear flange to pinion flange with four screws and lockwashers, tightening to 70 foot-pounds. *(See CAUTION on Page 4-3.)*

11. Remove jack stands and lower car. Vehicle is now at standing height.

12. Tighten upper control arm nuts to 75 foot-pounds. *(See CAUTION on Page 4-3.)*

CAUTION: Pivot bolt and nut in control arms must be torqued when normal vehicle weight is applied to axle. If not, the ride will be affected.

5. Rear Lower Control Arm

CAUTION: Be careful not to damage brake piping on axle housing throughout this procedure.

a. Removal (Fig. 4-1)

1. Raise rear end of car.
2. Remove front and rear lower control arm nuts.
3. Place jack under front of differential to relieve tension on lower arm bolts.
4. Remove front and rear lower control bolts and remove arm.

(Neither front nor rear bushings in the lower control arms are serviceable.)

b. Installation

1. Slide Lower control arm into position with the slotted hole in top of arm toward rear of car; flanged ends of bushings must face right side of car. Install front bolt from outboard side, and rear bolt from inboard side. Adjust jack under front of differential as necessary to install bolts.
2. Lower car.
3. Install front and rear lower control arm nuts, tightening to 75 foot-pounds. *(See CAUTION on Page 4-3.)*

CAUTION: Pivot bolts in control arms must always be torqued when full normal load is applied to axle. If not, the ride rate will be affected.

6. Rear Upper Control Arm

a. Removal

1. Raise rear end of car.
2. If car is equipped with Automatic Level Control, remove attaching nut that secures height control valve link to left upper control arm. Position overtravel lever in center position.
3. Place jack stand under differential pinion retainer.
4. Remove both front and rear mounting nuts from control arm bolts.
5. Remove both control arm pivot bolts and remove control arm. (Neither front nor rear upper control arm bushings are serviceable.)

b. Installation

1. Install control arm with flanged surfaces of bushings inboard.
2. Loosely install front pivot bolt and nut.
3. Loosely install rear pivot bolt and nut in axle bracket.
4. Lower car.
5. Tighten front and rear nuts to 75 foot-pounds. *(See CAUTION on Page 4-3.)*

(NOTE: Pivot bolts in control arms should be torqued only when full normal load is on axle. If not, the ride rate will be affected.)

6. If car is equipped with Automatic Level Control, secure link to left upper control arm with attaching nut. Inflate reservoir to 140 psi or maximum pressure available through compressor service valve.

7. Rear Leaf Spring Liner Service (Commercial Chassis)

Replacement rear spring liner tips are available for installation between the spring leaves when original liners wear at the outer ends.

To install these replacement liner tips, it is necessary to use a hardwood wedge 2-1/2 inches wide, 5 inches long, and tapered from 1/8 inch to 3/4 inch thick in 2 inches of length. Proceed as follows:

1. Remove spring rebound clips.
2. Raise rear of car until springs are in full rebound position.
3. Mark off length of replacement liner tip on main spring leaf, allowing 1/2 inch projection beyond second leaf.
4. After carefully placing a piece of sheet metal between liner and spring leaf to protect leaf, pry first and second leaf apart and insert wedge under liner just beyond old liner.

CAUTION: It is necessary to protect the spring leaf because a small nick in the leaf from a steel wedge could cause a point of fatigue that might result in spring failure. Use a hardwood wedge whenever possible.

5. Remove original liner.
6. Install new liner tip with button end toward axle. Work out wedge keeping liner tip in position.
7. Repeat above operation at each of the two upper liners in each rear spring.

8. Rear Leaf Spring (Commercial Chassis)

a. Removal

1. Raise car so that weight of body is entirely off the spring and support axle housing with adjustable stands.
2. Remove front eye bolt nut and drive out eye bolt.
3. Disconnect shock absorber from U-bolt plate.
4. Remove rear shackle link nuts, Fig. 4-5.
5. Remove U-bolt nuts, washers, lower spring plate, lower insulator retainer, and insulator pad.

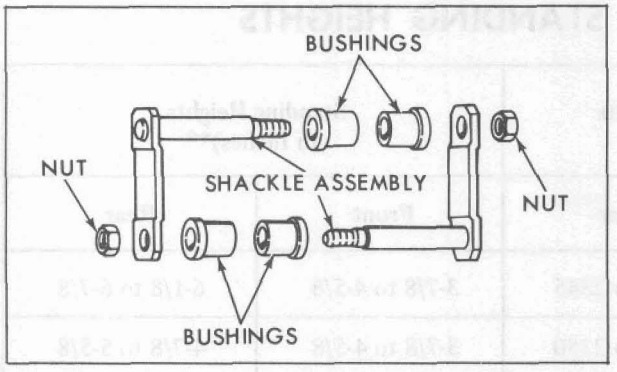


Fig. 4-5 Rear Leaf Spring Shackle

6. Remove spring from frame attachment by disconnecting rear shackle link assemblies.

b. Installation

1. Install new bushings in spring eyes and in shackle-to-frame mounting sleeves.
2. Install shackle link on frame.
3. Install shackle link on spring and attach this assembly to shackle link on frame. Install nuts loosely.
4. Line up front spring eye on bracket on frame and install bolt from inner side of frame. Install nut, but do not tighten until car is lowered.
5. Install insulator pad and retainer on top of spring, with hole in pad and retainer over spring center bolt.
6. Position center of spring under rear axle housing bracket with spring center bolt located in hole provided in bracket.
7. Install insulator pad, retainer, and U-bolts; and install U-bolt nuts and lockwasher, torquing to 45 foot-pounds.

(NOTE: Lower car before tightening U-bolts or rear shackle nuts. This permits rubber bushings to take a neutral position and assures a more accurate torquing.)

8. Connect rear shock absorber at spring U-bolt plate.
9. Tighten front eye bolt and rear shackle link nuts to 70 foot-pounds. *(See CAUTION on Page 4-3.)*

TORQUE SPECIFICATIONS

Material No.	Application	Size	Foot Pounds
300-M	All Upper and Lower Control Arm Nuts	1/2–13	75*
300-M	Rear Leaf Spring U-Bolt Nuts	1/2–13	45
1020	Rear Leaf Spring Front I-Bolt Nut	1/2–20	70*
1020	Rear Leaf Spring Shackle Nuts	1/2–20	70*
275-M	Rear Shock Absorber Bolts (upper)	5/16–18	12
286-M	Rear Self Locking Shock Attaching Nut (lower)	1/2–20	50

NOTE: Refer to back of Manual, Page 16-1 for Bolt and Nut Markings, and Steel Classifications.

**These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

REAR COIL SPRING CHART

Style	Letter Code and Color	Spring Load	Rate Per Inch
681	CK-Dark Blue	1150	85
68247, 68347	CP-Beige	1200	100
68247, 68347 with Automatic Level Control	CR-Maroon	1050	85
68249, 68349	CJ-Yellow	1250	100
68249, 68349 with Automatic Level Control	CM-Light Green	1100	85
697	CF-Chartreuse	1500	150
693	CE-Yellow	930	85

VEHICLE WEIGHTS AND STANDING HEIGHTS

Style		Observed Vehicle Weights (In Pounds)*		Standing Heights (In Inches)**	
		Front	Rear	Front	Rear
68247	Standard	2630 to 2680	2285 to 2345	3-7/8 to 4-5/8	6-1/8 to 6-7/8
	with ALC	2630 to 2680	2290 to 2350	3-7/8 to 4-5/8	4-7/8 to 5-5/8
68249	Standard	2705 to 2755	2345 to 2400	3-7/8 to 4-5/8	6-1/8 to 6-7/8
	with ALC	2705 to 2755	2350 to 2405	3-7/8 to 4-5/8	4-7/8 to 5-5/8
68347	Standard	2650 to 2700	2300 to 2360	3-7/8 to 4-5/8	6-1/8 to 6-7/8
	with ALC	2650 to 2700	2305 to 2365	3-7/8 to 4-5/8	4-7/8 to 5-5/8
68349	Standard	2700 to 2750	2375 to 2430	3-7/8 to 4-5/8	6-1/8 to 6-7/8
	with ALC	2700 to 2750	2380 to 2435	3-7/8 to 4-5/8	4-7/8 to 5-5/8
68169	ALC is Standard	2725 to 2775	2400 to 2460	3-3/4 to 4-1/2	4-7/8 to 5-5/8
69723	ALC is Standard	2980 to 3080	2745 to 2795	4-7/16 to 5-3/16	5-9/16 to 6-5/16
69733	ALC is Standard	3040 to 3140	2815 to 2865	4-7/16 to 5-3/16	5-9/16 to 6-5/16
69347	ALC is Standard	2965 to 3000	2020 to 2075	8 to 8-1/4	3.88 to 4.64
69367	ALC is Standard	2990 to 3025	2050 to 2100	8 to 8-1/4	3.88 to 4.64

(NOTE: On cars equipped with Automatic Level Control, first determine if the unit is working. Place weight of one man on rear bumper. Rear of car should lower and then raise after 4 to 18 seconds. Do not deflate system when checking trimmed standing height. If system is inoperative, see Note 14, Compressor Output Test and Note 15, Control Valve Test.)

*For cars without air conditioning, subtract 123 lbs. from front end weight.

**Springs can settle up to 3/8" during first 2500 vehicle miles. The values in this chart are for vehicles with settled springs. On new vehicles, add 3/8" to measurements given.

GENERAL DESCRIPTION

(NOTE: The following information is applicable only to the Eldorado.)

A four link, coil spring, rear suspension system is used on 693 series cars, Fig. 4-6. It consists of two upper and lower control arms, coil springs, and Automatic Level Control shock absorbers. NONE of these components are interchangeable with their counterparts in other Cadillac series.

Automatic Level Control is provided as standard equipment on the Eldorado and functions the same as on other series cars. The height control valve is located on the right side of the frame crossmember above the right rear upper control arm. Consequently, the right shock absorber has a double port, Fig. 4-12. Other components of the system are located similarly to those of the 681, 682, and 683 series. Service information pertaining to Automatic Level Control is covered at the end of this section, beginning on Page 4-13.

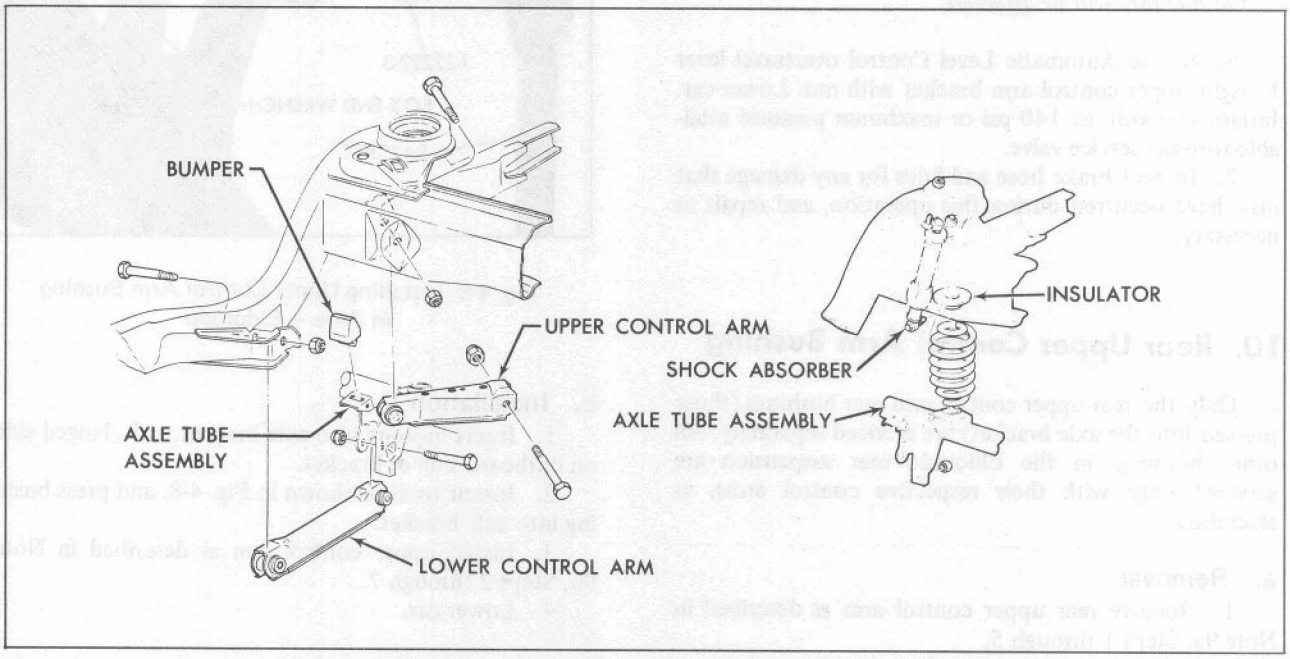


Fig. 4-6 Rear Suspension Eldorado Disassembled

SERVICE INFORMATION

The service information that follows pertains only to the Eldorado. For service information not given, refer to the forward portion of the appropriate subsection, as the procedures are the same as for other 1972 Cadillacs.

CAUTION: When raising rear of car, support vehicle weight at frame or axle or both. Never use control arms as contact points for hoist or jack stands.

CAUTION: If any mispositioning, incorrect disassembly or assembly, or failure of components in the area of the brake system pipes or hoses is observed, be sure to check for any damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect disassembly or assembly, or failure include the exhaust system, shock absorbers, springs, and suspension control arms.

9. Rear Upper Control Arm

a. Removal

1. Raise car on hoist and position jack stands at rear frame side members. Car is now supported at both frame and rear axle.
2. Disconnect Automatic Level Control system overtravel link at right upper control arm axle bracket and place overtravel lever at its centered position.
3. Disconnect shock absorber at its lower mount and position out of way.
4. Raise axle on hoist to relieve tension on upper control arm.
5. Remove bolt and nut securing upper control arm to rear axle bracket.
6. Remove bolt and nut securing upper control arm to frame cross member and remove arm.

b. Installation

1. Install control arm in its mounting brackets.
2. Loosely install bolts and nuts securing control

arm in mounting brackets, adjusting height of axle as necessary. (Do not torque bolts at this time.)

3. Guide shock absorber lower stem into lower mount, adjusting height of axle if necessary, and secure with retaining nut. Tighten to 50 foot-pounds.

4. Raise axle and remove jack stands.

5. Torque upper control arm bolts at frame crossmember to 100 foot-pounds and torque upper control arm bolts at axle bracket to 75 foot-pounds. *(See CAUTION on Page 4-3.)*

CAUTION: Pivot bolts in control arms must be torqued when full normal load is on axle. If not, the ride rate will be affected.

6. Secure Automatic Level Control overtravel lever to right upper control arm bracket with nut. Lower car. Inflate reservoir to 140 psi or maximum pressure available through service valve.

7. Inspect brake hose and lines for any damage that may have occurred during this operation, and repair as necessary.

10. Rear Upper Control Arm Bushing

Only the rear upper control arm rear bushings (those pressed into the axle bracket) are serviced separately. All other bushings in the Eldorado rear suspension are serviced only with their respective control arms, as assemblies.

a. Removal

1. Remove rear upper control arm as described in Note 9a, Steps 1 through 5.

2. Move control arm away from bushing.

3. Install tools as shown in Fig. 4-7, and press bushing from axle bracket.

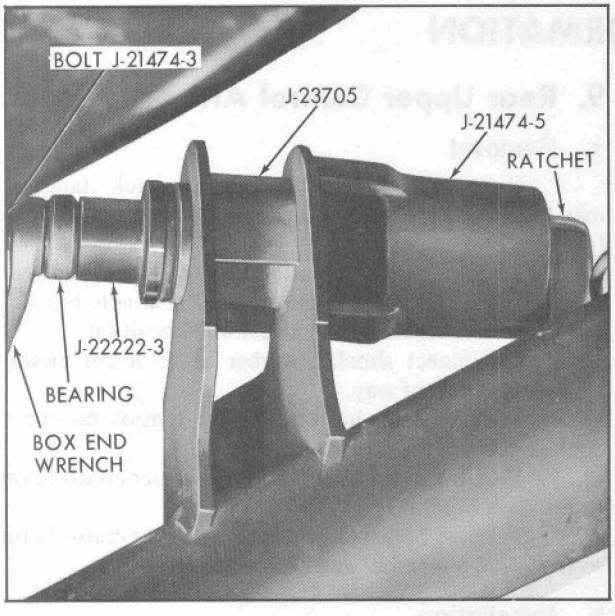


Fig. 4-7 Removing Upper Control Arm Bushing from Axle — Eldorado

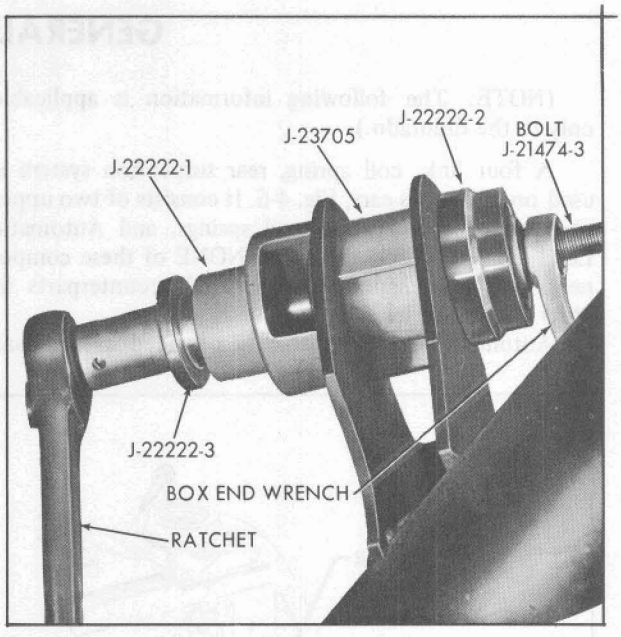


Fig. 4-8 Installing Upper Control Arm Bushing In Axle — Eldorado

b. Installation

1. Insert bushing into axle bracket with flanged side on outboard side of bracket.

2. Install tools as shown in Fig. 4-8, and press bushing into axle bracket.

3. Install upper control arm as described in Note 9b, Steps 2 through 7.

4. Lower car.

11. Lower Control Arm

a. Removal

1. Raise car on hoist.

2. Remove bolts and nuts securing lower control arm to axle and frame side member brackets and remove control arm.

b. Installation

1. Position lower control arm in frame side member and axle brackets and insert bolts and nuts. Do not torque at this time.

2. Inspect brake lines and hose for any damage that may have occurred during this operation, and repair as required.

3. Lower car.

4. Tighten control arm bolts to 100 foot-pounds while holding nuts stationary. *(See CAUTION on Page 4-3.)*

CAUTION: Pivot bolts in control arms must be torqued when axle is under normal load. If not, the ride rate will be affected.

12. Rear Springs

a. Removal

1. Perform procedure in Note 9a to remove both

rear upper control arms from axle brackets and to remove both shock absorbers from their lower mounts.

2. Disconnect brake hose and cap brake system to minimize leakage.

3. WARNING: IF AXLE IS LOWERED BEYOND FULL REBOUND POSITION, SPRINGS MAY SNAP FROM SPRING SEATS. FOR THIS REASON, LOWER AXLE TO A POSITION JUST SHORT OF FULL REBOUND, THEN COMPRESS SPRING BY HAND AND REMOVE FROM SPRING SEATS.

Lower axle carefully until springs can be removed manually.

b. Installation

1. Inspect rubber insulator in upper spring mounts for damage and proper position.

2. Insert springs and raise axle until springs are fully seated, and upper end of springs positioned within limits shown in Fig. 4-9.

3. Install upper control arms, shock absorbers, and connect Automatic Level Control, as described in Note 9b, Steps 1 through 6.

4. Connect brake hose and bleed brakes as described in Section 5, Note 6.

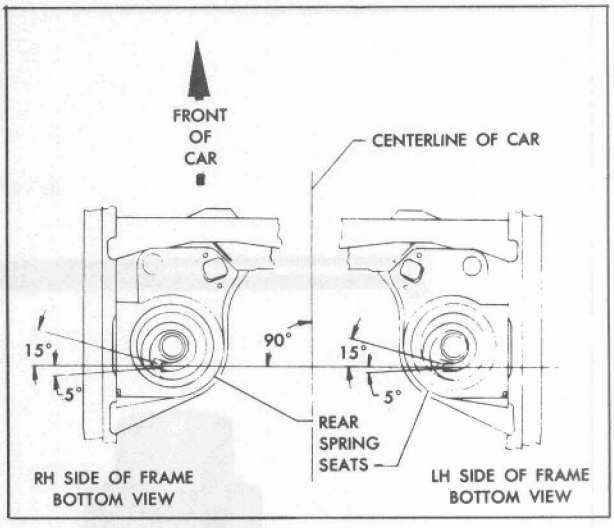


Fig. 4-9 Coil Spring Indexing – Eldorado

TORQUE SPECIFICATIONS—ELDORADO

Material No.	Application	Size	Foot-Pounds
300-M	Rear Upper Control Arm Bolts (at axle bracket)	1/2–13	75*
300-M	Rear Upper Control Arm Bolts (at frame cross member)	9/16–12	100*
300-M	Rear Lower Control Arm	9/16–12	100*
275-M	Rear Upper Shock Absorber Bolts	5/16–18	12
286-M	Rear Lower Shock Absorber Attaching Nuts	1/2–20	50

**These control arm fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure the proper retention of these parts.*

Pivot bolts in control arms must be torqued when axle is under normal load. If not, the ride rate will be affected.

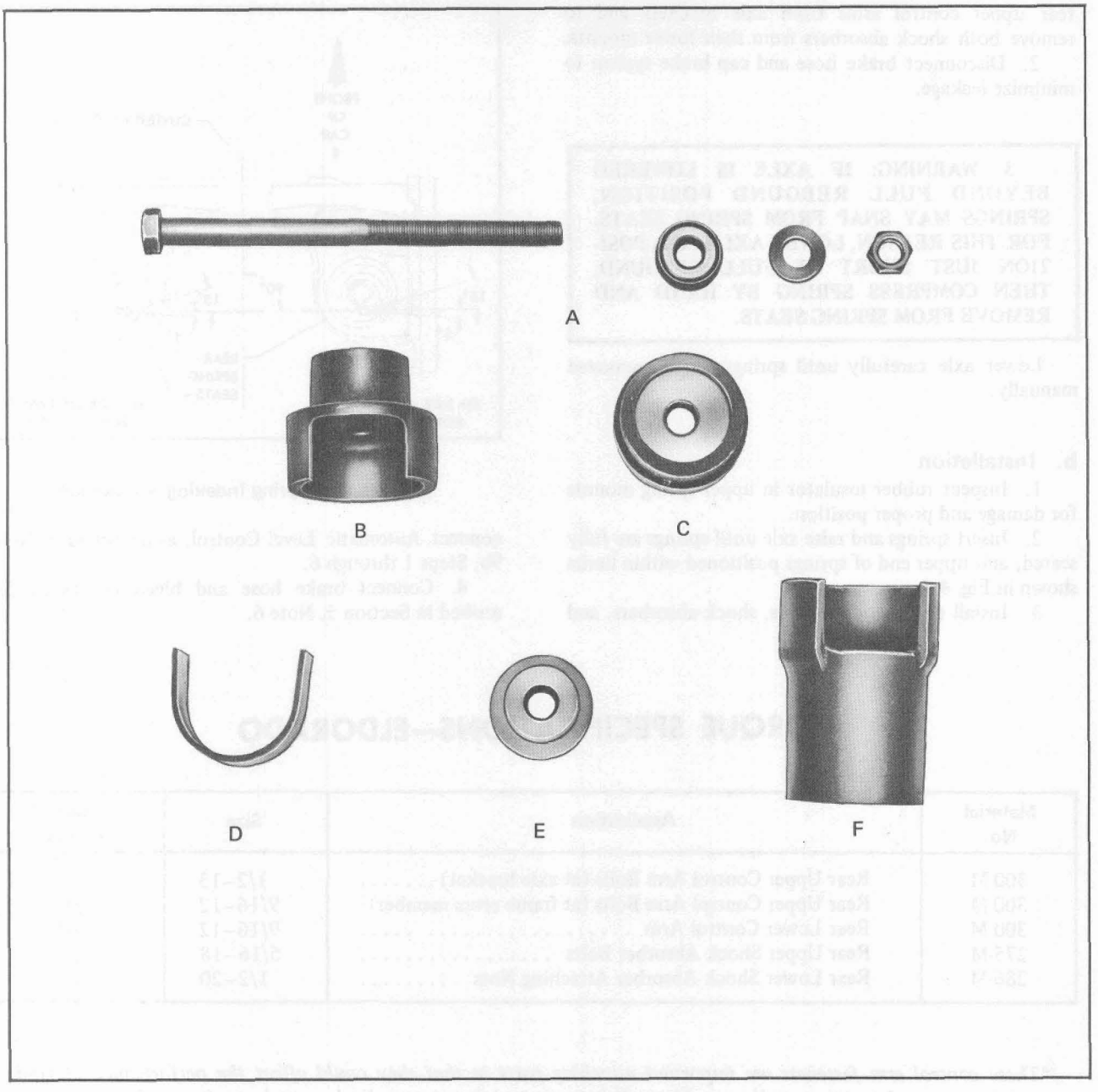


Fig. 4-10 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-21474-3	Driver Bolt Set	D	J-23705	Spacer
B	J-22222-1	Bushing Installer	E	J-22222-3	Pilot
C	J-22222-2	Pilot	F	J-21474-5	Bushing Remover

GENERAL DESCRIPTION

System (Fig. 4-11)

Automatic Level Control is provided as standard equipment on the Eldorado, Fleetwood Sixty Special Brougham, and the Fleetwood Seventy-Five Sedan and Limousine, and is optional on all other models. The system consists of an air compressor and tank assembly, pressure regulator, control valve and link, two superlift rear shock absorbers, and flexible air lines.

As load is added, the shock absorbers inflate and extend, raising the car to its initial level. As load is removed the shock absorbers deflate and retract, lowering the car to its initial level. After completion of work on this system, or when servicing other parts of the car and the system is discharged, charge the reservoir to 140 psi or maximum pressure available, by applying dry air through the compressor service valve located on the pressure regulator.

CAUTION: It is essential that no oil is fed into system. Do not use an air source that utilizes an oil mist for lubrication.

Compressor and Reservoir

The compressor operates on the difference between (1) engine manifold vacuum, supplied to the compressor by a line connected to the crankcase ventilator valve vacuum line, and (2) a higher pressure air at or near atmospheric pressure, available through an air supply line at the air cleaner.

The compressor supplies high pressure air to the reservoir. The compressor is a two-stage type, designed to operate intermittently to replenish air used from the reservoir. It requires no lubrication. As the compressor cycles, the reservoir air pressure gradually increases, causing a back pressure on the second stage piston until it equals the push of atmospheric pressure against the diaphragm. At this point, a balanced condition is reached and the unit stops operating. After reservoir pressure drops due to system air usage, the compressor again begins to cycle and replenish the reservoir.

Balance pressure will depend upon the prevailing manifold vacuum at the carburetor insulator and prevailing atmospheric pressure. Both are affected by altitude above or below sea level. Balance pressure will vary from approximately 150 psi to 275 psi.

Pressure Regulator

A pressure regulator is attached to the output side of the reservoir. It regulates shock absorber pressure to approximately 125 psi.

Control Valve and Link

The rear standing height is automatically maintained at a nearly constant position by a control valve attached to the rear suspension cross member. A link attaches the valve lever to the axle assembly. On all styles except the Eldorado, the attaching point is on the left upper control arm.

(NOTE: There are two attaching nut holes in the overtravel lever; the upper hole is to be used on 681, 682 and 683 vehicles and the lower hole is for the 697 only.)

On the Eldorado, the link attaches to the right upper control arm axle bracket; and the right superlift, rather than the left, has a double port, Fig. 4-12.

When sufficient load is added to deflect the rear suspension at least 1/2 inch, the control valve admits air to the shock absorbers, which then raise the car to level. When load is removed, and the car rises, the control valve exhausts air from the shock absorbers, which lower the car to level. A four to eighteen second time delay mechanism inside the control valve housing prevents transfer of air when the lever is moved during normal ride motions. In this manner the control valve responds only to actual load changes of sufficient duration to overcome the delay action.

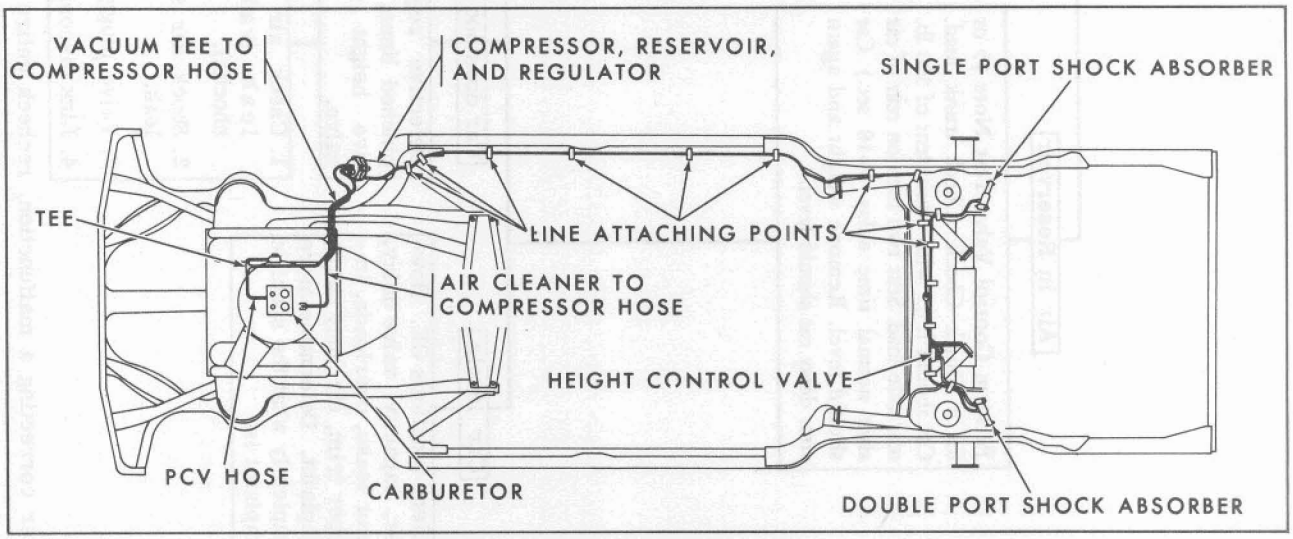
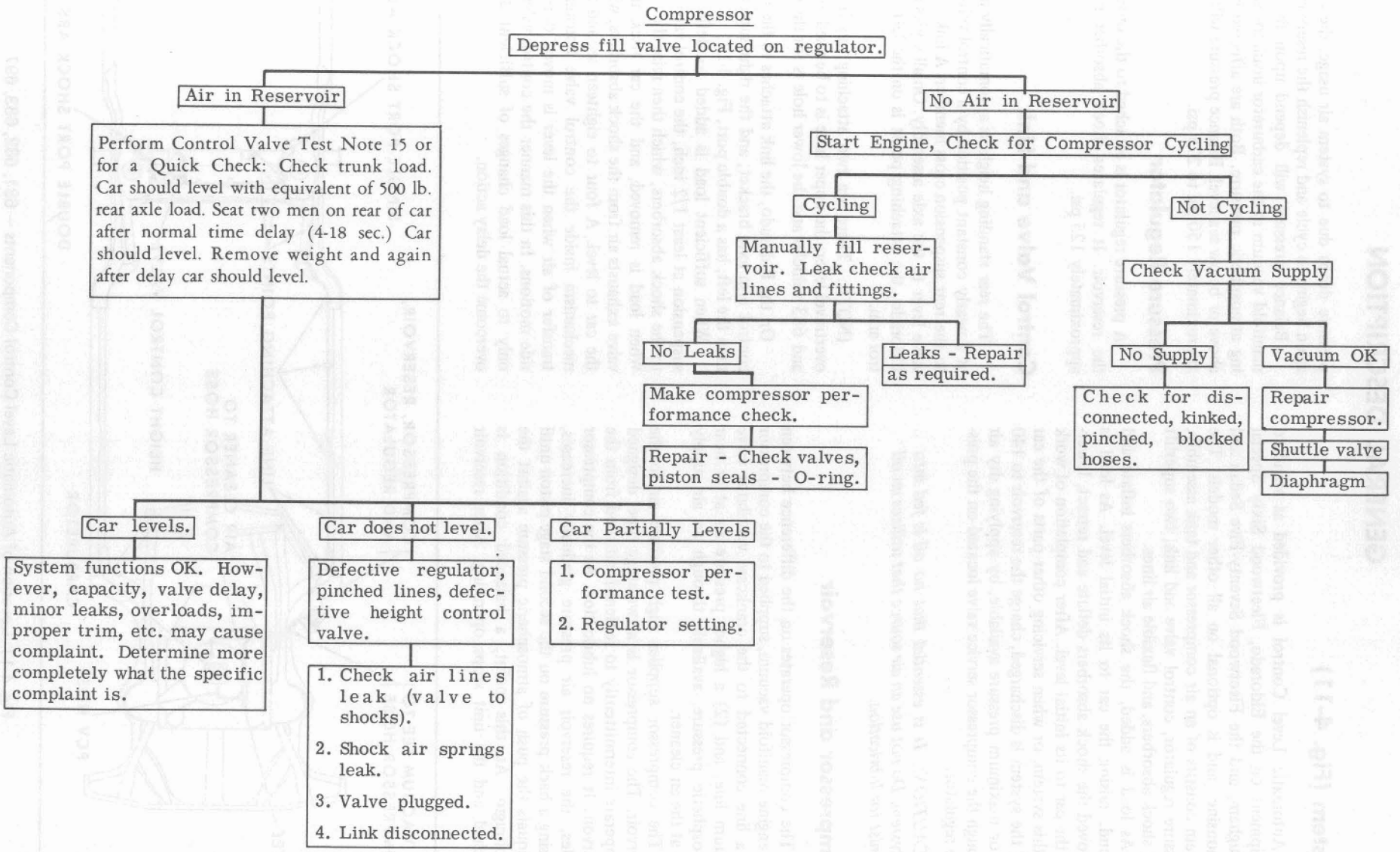


Fig. 4-11 Location of Automatic Level Control Components – 681, 682, 683, 697

DIAGNOSIS CHART (AUTOMATIC LEVEL CONTROL)



After correcting a malfunction, recheck entire system.

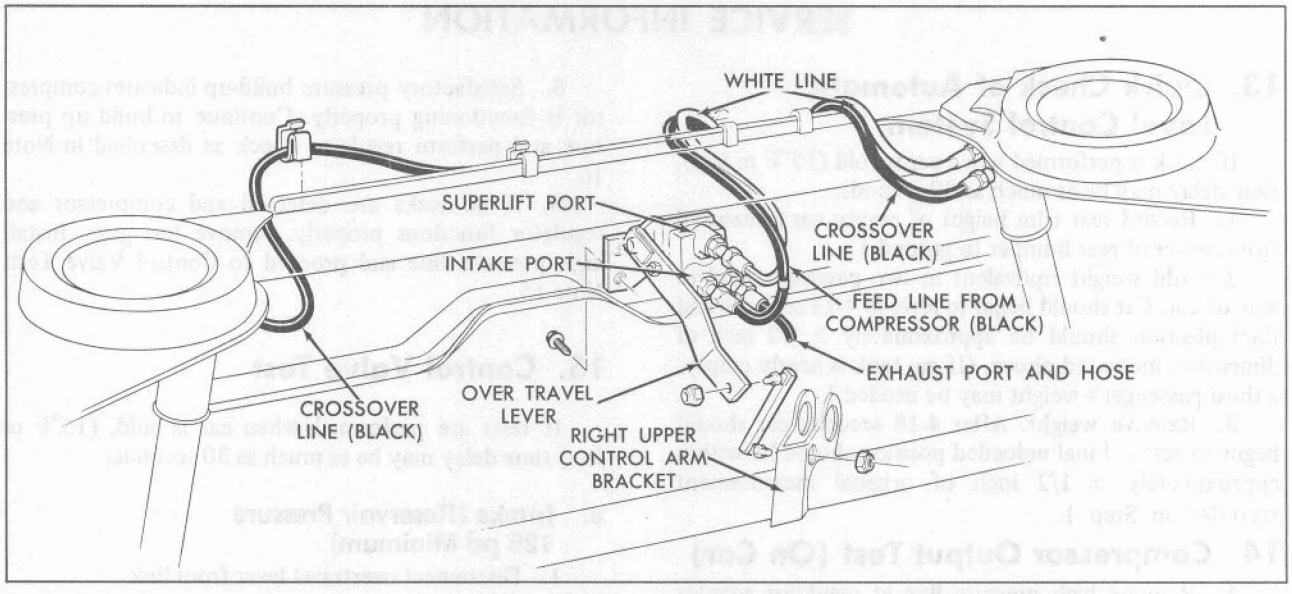


Fig. 4-12 Location of Automatic Level Control Components – Eldorado

Superlift Rear Shock Absorber (Fig. 4-13)

The superlift shock absorber is essentially a conventional shock absorber enclosed in an air chamber. A pliable nylon reinforced neoprene boot seals the dust tube (air dome) to the reservoir tube (air piston). The unit will extend when inflated and retract when deflated by the control valve. The units are connected by a flexible air line which equalizes the air pressure in the two shock absorbers.

An eight to fifteen psi air pressure is maintained in the shock absorbers at all times to minimize boot friction. This is provided by a check valve in the exhaust fitting on the control valve.

Lines and Fittings

Flexible air lines of 1/8 inch diameter tubing are used throughout the system. Each fitting consists of a rubber seal, metal sleeve, and nut. These parts are designed specifically for the 1/8 inch diameter line and must be used to effect a reliable seal.

While the lines are flexible for easy routing and handling, care should be taken not to kink them and to keep them from coming in contact with the exhaust system.

Dealer Installation

As a dealer-installed option, the Automatic Level Control system may be installed either by retaining standard suspension springs or by changing to the optional spring, as the customer desires.

The standard spring will provide approximately 150 lbs. additional load carrying capacity, but will have a firmer ride and will trim at the same height as cars without the level system.

The special Automatic Level Control spring installed at the factory, and available in service, provides a softer ride and lower rear trim height while maintaining the level conditions for average passenger and trunk loads.

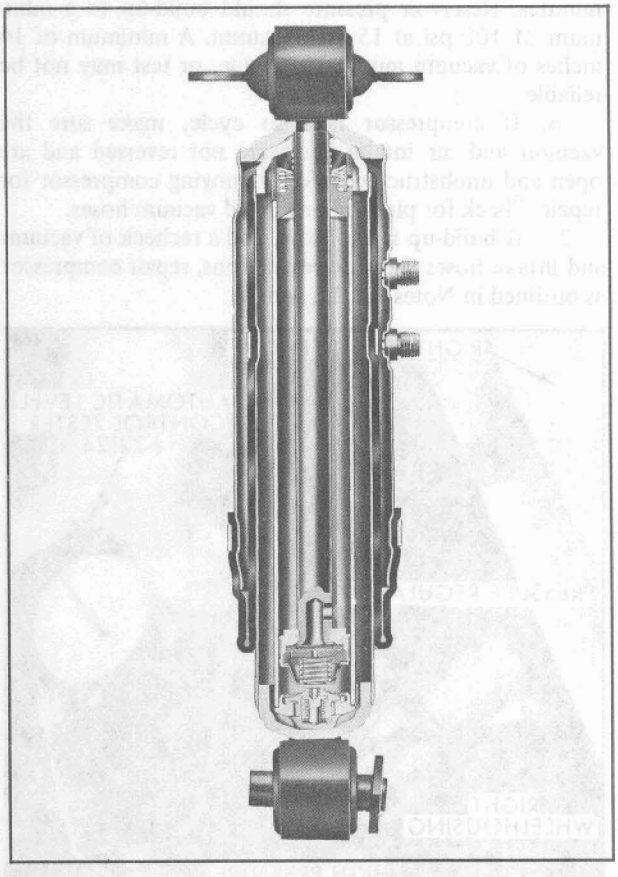


Fig. 4-13 Rear Shock Absorber (Automatic Level Control)

SERVICE INFORMATION

13. Quick Check of Automatic Level Control System

If check is performed when car is cold (15°F or less), time delay may be as much as 30 seconds.

1. Record rear trim height of empty car (measured from center of rear bumper to ground.)
2. Add weight equivalent to two passenger load to rear of car. Car should begin to level in 4-18 seconds and final position should be approximately ± 1/2 inch of dimension measured above. (If gas tank is nearly empty, a third passenger's weight may be needed.)
3. Remove weight. After 4-18 seconds car should begin to settle. Final unloaded position should be within approximately ± 1/2 inch of original measurement recorded in Step 1.

14. Compressor Output Test (On Car)

1. Remove high pressure line at regulator adapter fitting and connect Test Gage, J-22124, Fig. 4-14.
2. Deflate reservoir to 70 psi through service valve.
3. Observe Test Gage for evidence of compressor air leak.
4. If compressor is leaking, proceed to leak test compressor reservoir and regulator as described in Note 17a. If not leaking, continue this test.
5. With engine running at slow idle and reservoir pressure at 70 psi, observe reservoir build-up for five minutes. Reservoir pressure should build-up to a minimum of 100 psi at 15 inch vacuum. A minimum of 14 inches of vacuum must be available, or test may not be reliable.
6. If compressor fails to cycle, make sure the vacuum and air intake liners are not reversed and are open and unobstructed before removing compressor for repair. Check for pinched or kinked vacuum hoses.
7. If build-up is too slow, and a recheck of vacuum and intake hoses show no restrictions, repair compressor as outlined in Notes 22, 23, and 24.

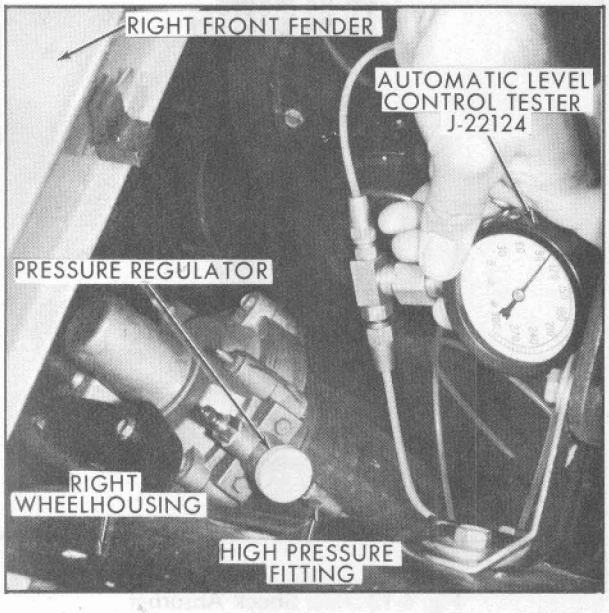


Fig. 4-14 Testing Compressor Output

8. Satisfactory pressure build-up indicates compressor is functioning properly. Continue to build up pressure and perform regulator check as described in Note 16.
9. If no leaks are detected and compressor and regulator functions properly, remove test gage. Install high pressure line and proceed to Control Valve Test, Note 15.

15. Control Valve Test

If tests are performed when car is cold, (15°F or less) time delay may be as much as 30 seconds.

a. Intake (Reservoir Pressure 125 psi Minimum)

1. Disconnect overtravel lever from link.
2. Hold lever up in intake position until shock absorbers inflate or for a minimum of 18 seconds.
3. If shock absorbers inflate and hold, proceed to Time Delay Check.
4. If shock absorbers inflate and then leak down, perform leak test on lines and fittings and then on shock absorbers, Note 17d.
5. If shock absorbers inflate with the lever in the neutral position, perform leak check on valve.
6. If shock absorbers do not inflate, check air source. Also check and, if necessary, replace intake and shock absorber screens and O-rings. If shock absorbers still do not inflate, perform leak test on valve, Note 17b. Repair as indicated and proceed to time-delay check.

b. Exhaust (Shock Absorbers Inflated)

1. Disconnect overtravel lever from link.
2. Hold lever down in exhaust position until shock absorbers deflate or for a minimum of 18 seconds.
3. If shock absorbers deflate, perform Intake Check.
4. If shock absorbers do not deflate, remove exhaust adapter from control valve and hold lever down as in Step 2. Replace adapter, O-ring, and filter if this deflates shock absorbers.
5. If shock absorbers deflate with lever in neutral position, perform leak checks on lines and fittings. If continuous leakage appears at exhaust valve port, check control valve for leaks, Note 17b.
6. Replace control valve if none of the above steps correct the condition.

c. Time Delay Check

1. Disconnect overtravel lever from link.
2. Disconnect lines at shock absorbers and intake ports.
3. Connect Test Gage J-22124, to intake valve port and open air pressure (95 psi). Move overtravel lever approximately one inch down from neutral position as measured from end of lever, and hold for 15-20 seconds.
4. Quickly move overtravel lever upward two inches and note number of seconds before air starts to escape from shock absorber port. This delay should be from

4-18 seconds. Repeat check. This will check the air intake time delay. Proceed with check to determine air exhaust time delay.

5. Remove Test Gage and plug intake port with Fill Valve, J-21999, (female end).

6. Connect Test Gage to shock absorber port and open air pressure (95 psi). Move overtravel lever approximately one inch up from neutral position as measured from end of lever, and hold for 15-20 seconds.

7. Quickly move overtravel lever downward two inches; at the same time begin timing number of seconds until air begins to escape from exhaust port. This delay should be 4-18 seconds. Repeat check.

If either delay is not within specification, replace the leveling control valve and proceed to Trim Adjustment On Car, Note 18.

16. Regulator Test

Performance test the regulator with a known good compressor on the car.

1. Deflate system through service valve, remove line at regulator and connect Test Gage, J-22124, at regulator adapter.

2. Inflate reservoir through service valve to maximum pressure available. If less than 140 psi, start engine to build up reservoir to this pressure.

3. Regulated pressure on the Test Gage should build up to 100-130 psi and hold steady within this pressure.

4. Recheck regulated pressure by momentarily depressing valve core on Test Gage and observe gage reading.

5. If regulated pressure exceeds 130 psi, replace regulator as a unit.

17. Leak Tests

a. Compressor, Reservoir, and Regulator

1. Remove assembly, Note 21a.

2. Connect Test Gage to regulator. Inflate reservoir through service valve to 80-110 psi.

3. Route an eight inch rubber hose between vacuum and vent ports, Fig. 4-15.

4. While holding assembly in a vertical position with reservoir end down, immerse in water until the diaphragm is just submerged, Fig. 4-15. Do not submerge completely, as water can enter around the cover gasket. Observe for air leaks at:

- Reservoir weld seam.
- Reservoir to compressor O-ring. A stream of bubbles may appear in this area and then cease. The bubbles are caused by atmospheric air being purged from air pockets in the second stage housing. If the bubbles stop in 20 seconds or less there is no leak.
- Regulator to compressor O-ring.
- Regulator boot - defective internal O-ring.
- Diaphragm between first and second stage housings - tightening through-bolts may correct the leak.
- Service valve.
- Test gage connections.

5. Remove hose from vacuum port and submerge disconnected end in water. Cover vacuum port with finger. Do not permit water to enter through vacuum port. If bubbles are evident, the probable cause is a defective second stage housing check valve.

6. Correct any leaks by either tightening screws or replacing parts.

7. If the cover gasket area is inadvertently submerged, remove cover and tilt unit so that water may drain through openings by distributor valve mechanism. Move distributor valve from side to side until all water is purged. Dry both the distributor valve mechanism and the interior of the cover with compressed air. Replace cover.

If the compressor passes this test, yet fails the output test, overhaul the compressor, reservoir, and regulator assembly.

b. Control Valve

1. Remove control valve from car as described in Note 20a.

2. Clean exterior of control valve thoroughly.

3. Connect Test Gage, J-22124, and air pressure source to intake adapter and open air pressure (80-110 psi).

4. Submerge unit in water. No air should escape if overtravel lever is in "neutral" position. If bubbles escape from shock absorber port, proceed to step 8.

5. Shut off air pressure and detach test gage from air intake port. Plug intake port with Fill Valve, J-21999, (female end).

6. Connect Test Gage to shock absorber port and open air pressure.

7. With overtravel lever in "neutral" position no air should escape. If bubbles escape from exhaust port, proceed to step 8.

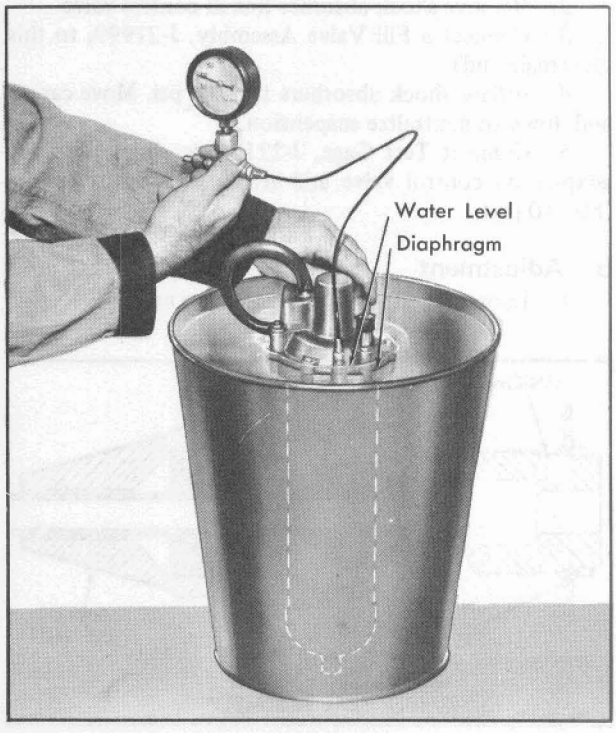


Fig. 4-15 Checking Compressor Assembly for Leaks

8. If the intake valve or exhaust valve is leaking with the lever in the neutral position, as evidenced in Step 5, Notes 15a and 15b, remove the cover plate and clean out the valve body. Blow air through the intake and exhaust valves while actuating the valves with the lever arm, do not remove the valve cores as they are selected and calibrated in each valve.

9. Install gasket and cover plate and check for leaks. If the valve cores still leak, replace the control valve.

c. Lines and Fittings

1. Disconnect overtravel lever from link.
2. Hold lever up in intake position for maximum shock absorber inflation and release.
3. Leak check all connections, with a soap and water solution. Leak test solution may also be used.

d. Shock Absorbers

1. Disconnect lines and remove shock absorber from car as described in Note 2a.
2. Inflate individually to 50-60 psi, utilizing Fill Valves, J-21999. Submerge in water and observe for leaks.
3. Install shock absorbers as described in Note 2b.

18. Trim Adjustment (On Car)

Trim adjustment should be performed with a full fuel tank (or the equivalent in load at the rate of 6 lbs/gallon).

a. Preparation

1. Raise car with rear axle supported.
2. Remove shock absorber line at control valve.
3. Connect a Fill Valve Assembly, J-21999, to this line (male end).
4. Inflate shock absorbers to 8-15 psi. Move car up and down to neutralize suspension.
5. Connect Test Gage, J-22124, to shock absorber adapter on control valve and attach air pressure source (80-110 psi).

b. Adjustment

1. Loosen overtravel lever adjusting nut.

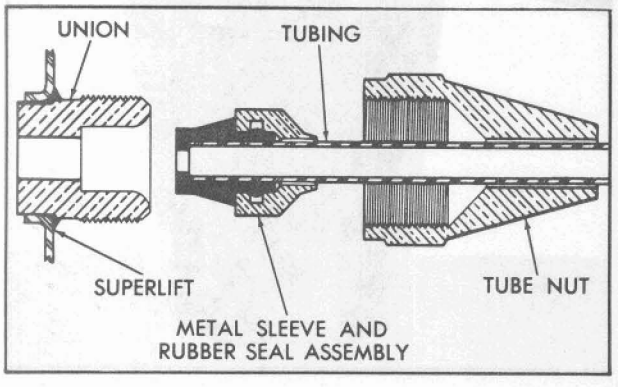


Fig. 4-16 Typical Tubing Fitting

2. Hold overtravel body down in exhaust position until air escapes from exhaust valve port.
3. Slowly move overtravel body and tighten nut at the point of minimum air bleed. With nut tight, a slight continuous air bleed will still be noticeable.

c. Restore System

1. Remove Test Gage and air pressure source from shock absorber adapter.
2. Remove Fill Valve Assembly, J-21999, from shock absorber line and reconnect line to control valve.
3. Lower car and inflate reservoir through service valve.

19. Tubing

(NOTE: Tubing may be removed by simply unscrewing nut. Be sure system is deflated when separating air lines. When installing tubing at any Automatic Level Control fitting, be careful not to kink line.)

1. Preassemble metal sleeve and rubber seal, Fig. 4-16.
2. Place nut on tubing.
3. Insert tube into metal sleeve and rubber seal until tube bottoms.

(NOTE: Be careful not to extend tubing completely through rubber seal.)

4. Holding tubing in bottomed position, tighten tube nut securely (30-40 inch pounds).

(NOTE: Tubing may be reinstalled at its connections. If tubing is cracked at end, it will be necessary to cut flush and use a new metal sleeve and rubber seal to assemble connector. Be careful not to remove too much, or tubing may be kinked or broken at full suspension travel. Care should be taken that proper routing is followed in areas close to the exhaust system to prevent burning the tubing. Note particularly the areas at rear suspension cross member.)

20. Height Control Valve

a. Removal

1. Deflate system, using service valve.
2. Disconnect air lines at leveling valve intake and shock absorber ports.
3. Disconnect link from overtravel lever by removing nut.
4. Remove two screws securing leveling valve to frame and remove leveling valve.

b. Installation

1. Install leveling valve with two screws, with time delay mechanism down.
2. Secure link to overtravel lever with retaining nut.

(NOTE: If working on limousine, use lower hole in overtravel lever.)

3. Connect air lines at control valve intake and at shock absorber port, assembling tubing as described in Note 19.

(NOTE: Line from upper port of control valve to double port shock absorber is white. This white line can be connected to either upper or lower port of shock absorber.)

4. Inflate reservoir to 140 psi or maximum pressure available through service valve.

21. Compressor, Regulator, and Reservoir Assembly

a. Removal

1. Raise hood.

(NOTE: Compressor is on rear of right wheelhousing.)

2. Remove air intake and vacuum hoses from compressor fittings.
3. Remove high pressure line from regulator fitting.
4. Remove three screws securing compressor to rear of right wheelhousing, screws are accessible inside wheelhousing.
5. Remove compressor and brackets from wheelhousing.
6. Remove nuts and lockwashers securing mounting brackets to flexible mounts on compressor assembly and remove mounting brackets.

b. Installation

1. Position mounting brackets to flexible mounts and secure with lockwashers and nuts.
2. Position mounting brackets to right wheelhousing with compressor end of assembly facing up.
3. Install three screws securing compressor to wheelhousing.
4. Install high pressure line on regulator fitting, following procedure described in Note 19.
5. Install air inlet hose (yellow striped) to vent fitting, Fig. 4-17.
6. Install vacuum hose (black) to vacuum fitting.
7. Inflate reservoir to 140 psi or maximum pressure available through service valve.
8. Lower hood.

22. Disassembling Compressor, Reservoir, and Regulator into Major Components (Fig. 4-18)

The compressor is a precision-built mechanism. All parts should be carefully handled and assembled. Take care to prevent entrance of dirt or foreign matter. DO NOT LUBRICATE as unit is designed to run dry.

1. Remove compressor as described in Note 21a.
2. Remove two flexible mounts and two adapters.
3. Remove reservoir retaining through bolt, cover retaining screw, and cover gasket that secure cover and gasket to first stage housing. Remove cover and discard gasket, if necessary.
4. Remove two regulator retaining screws, regulator assembly, and O-ring from second stage housing. Discard O-ring, if necessary.
5. Remove three nuts at reservoir flange and two through bolts that enter from flanged side of reservoir. Separate reservoir and O-ring. Discard O-ring, if necessary.
6. Remove three compressor retaining through bolts that secure second stage housing to first stage housing.

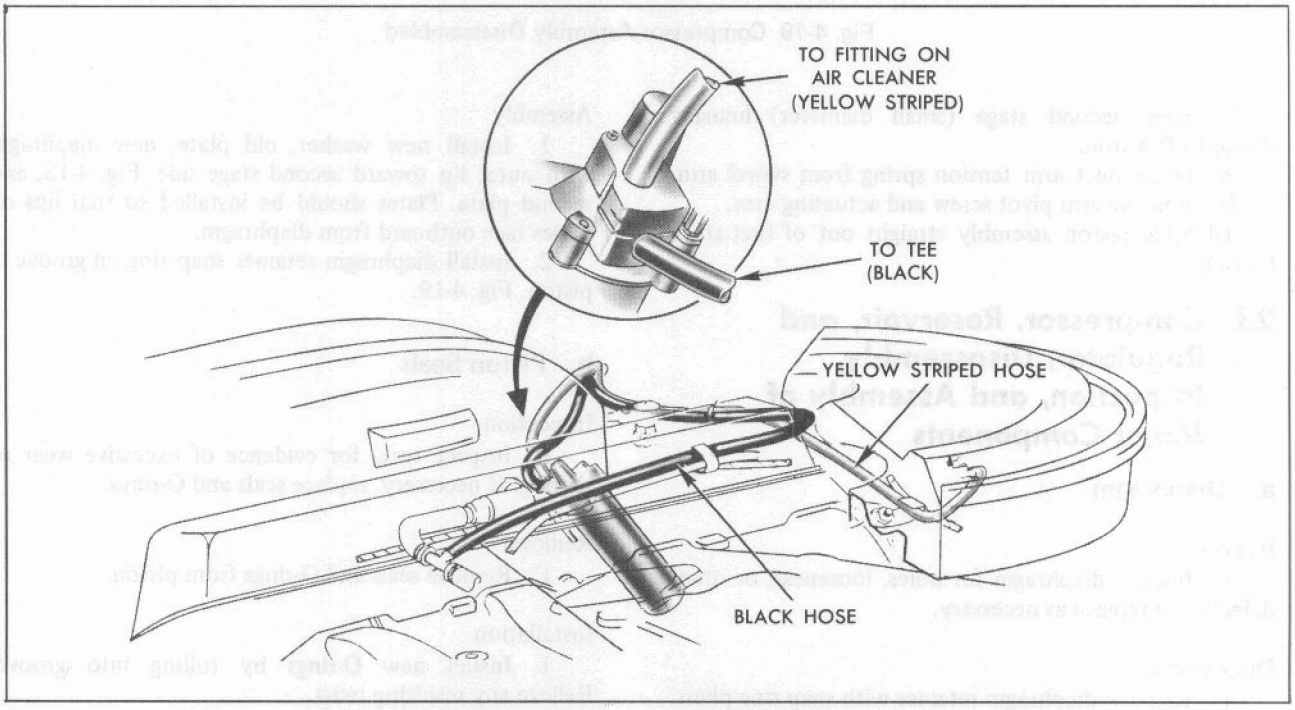


Fig. 4-17 Automatic Level Control Compressor Hose Connections

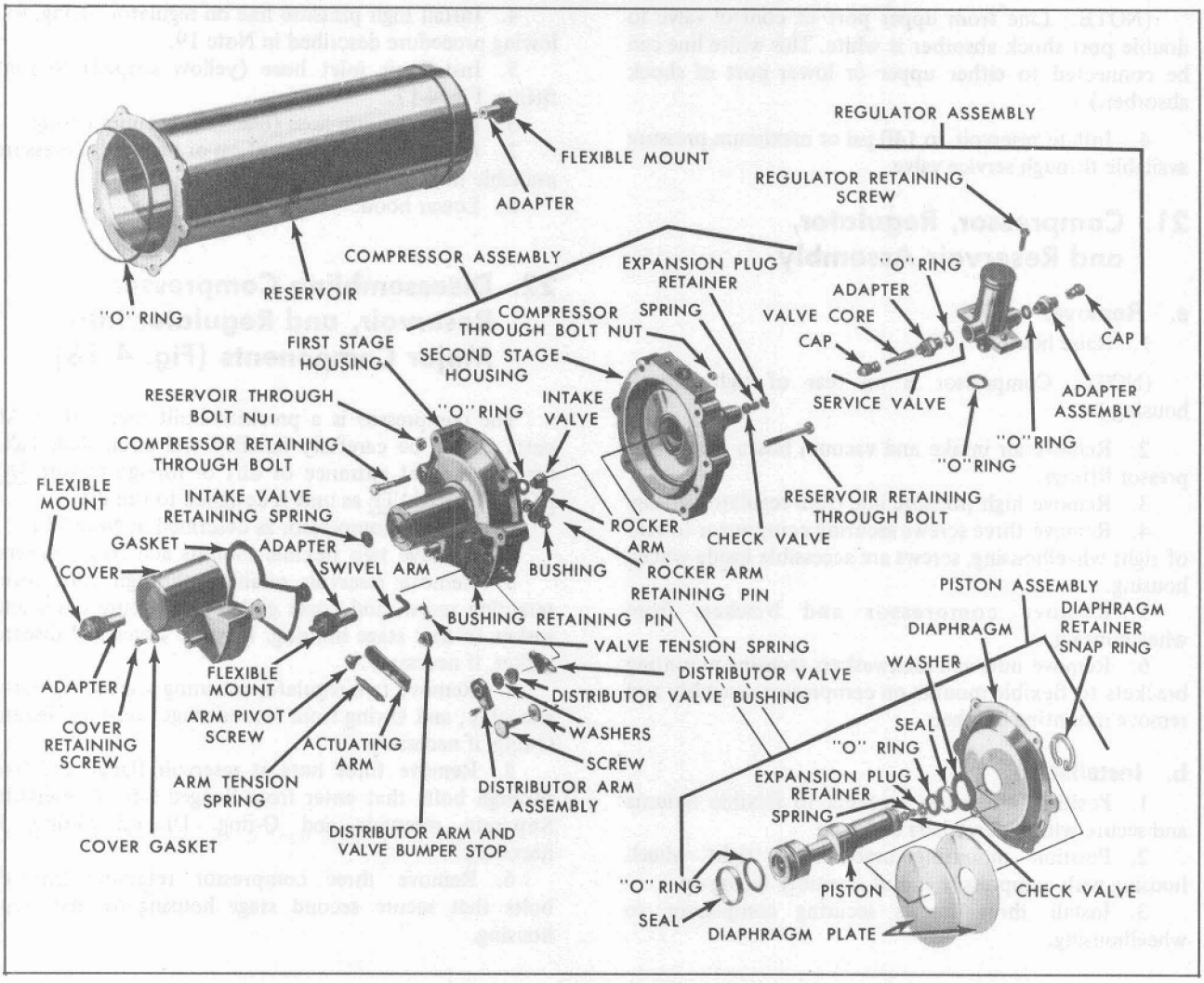


Fig. 4-18 Compressor Assembly Disassembled

7. Slide second stage (small diameter) housing straight off piston.
8. Disconnect arm tension spring from swivel arm.
9. Remove arm pivot screw and actuating arm.
10. Slide piston assembly straight out of first stage housing.

23. Compressor, Reservoir, and Regulator; Disassembly, Inspection, and Assembly of Major Components

a. Diaphragm

Inspection

1. Inspect diaphragm for holes, looseness, or other defects and replace as necessary.

Disassembly

1. Remove diaphragm retainer with snap ring pliers.
2. Remove diaphragm plate, diaphragm, second diaphragm plate, and washer from piston.

Assembly

1. Install new washer, old plate, new diaphragm with outer lip toward second stage side, Fig. 4-18, and second plate. Plates should be installed so that lips on plates face outboard from diaphragm.
2. Install diaphragm retainer snap ring on groove in piston, Fig. 4-19.

b. Piston Seals

Inspection

1. Inspect seals for evidence of excessive wear or scoring. If necessary, replace seals and O-rings.

Removal

1. Remove seals and O-rings from piston.

Installation

1. Install new O-rings by rolling into groove. Relieve any resulting twist.
2. Install new seals using a piece of .020" shim stock, Fig. 4-20. Make sure shim stock has no sharp

edges that may cut seal. Do not stretch seal more than necessary to install. Seals should be installed so they are not twisted.

c. Distributor Valve Mechanism and Intake Valve (First Stage Housing)

(NOTE: Actuate distributor valve with finger. Valve tension spring should press against distributor valve, holding it against either stop. If valve action is not free and positive, it will be necessary to rebuild, using new parts in distributor valve and arm package. If action is free and positive, and inspection upon disassembly shows no damage parts, parts may be re-used.)

Disassembly

1. Remove screw, washer, distributor arm assembly, washer, and distributor valve bushing.
2. Remove two distributor valve and arm assembly bumper stops.
3. Remove distributor valve, being careful not to distort valve tension spring.
4. Remove distributor valve tension spring from first stage housing boss, again being careful not to distort valve tension spring.
5. Remove intake valve retaining spring, intake valve, and washer, using pocket knife.
6. If necessary, remove rocker and swivel arms. Grip pin with water pump pliers and remove pin. Remove swivel arm, rocker arm, and bushings.

Cleaning and Inspection

1. Clean all parts in clean solvent except distributor arm assembly and blow dry with compressed air.
2. Inspect distributor valve for cracks. Discard if damaged.
3. Inspect all other parts for wear or damage.

Assembly

1. If removed, position bushings in first stage housing and install rocker arm and swivel arm. Align hole in rocker arm with swivel arm and install rocker arm retaining pin, small end first. Check for clearance of pin to housing.

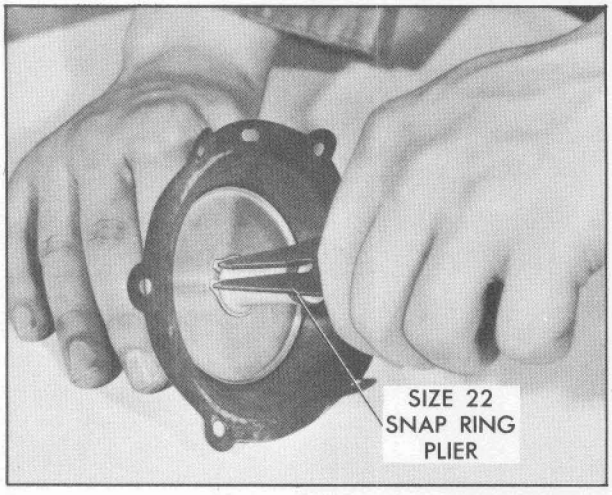


Fig. 4-19 Installing Diaphragm Retainer Snap Ring

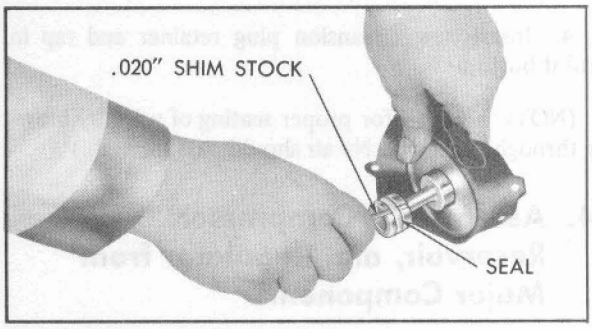


Fig. 4-20 Installing Seal

(NOTE: If distributor mechanism failed to function properly or one or more parts were found defective, use new parts in distributor valve and arm package during remaining build-up.)

2. Install washer on intake valve and install in first stage housing with intake valve retaining spring. Check for proper seating of valve by blowing air from piston side. No air should pass through valve.
3. Install longer leg of valve tension spring into boss on first stage housing, being careful not to distort valve tension spring.
4. Position distributor valve, being careful not to distort valve tension spring.
5. Install two distributor valve and arm assembly bumper stops.
6. Install distributor valve bushing, washer, distributor arm assembly, and washer and secure with screw. Tighten to 12 inch-pounds.

(NOTE: Do not install remaining parts at this time as rocker arm must be free to permit entrance of piston into first stage housing.)

d. Check Valve Replacement (Second Stage Piston)

1. Pry out expansion plug retainer on second stage piston, with pointed tool and remove spring and check valve.
2. Pour a small amount of clean solvent through bore in piston and blow dry with compressed air. Check valve seat should be smooth and clean.
3. Install new check valve and spring.
4. Insert new expansion plug retainer and tap in until it bottoms.

(NOTE: Check for proper seating of valve by blowing through small end of piston. No air should pass through.)

e. Check Valve Replacement (Second Stage Housing)

1. Pry out expansion plug retainer on second stage housing with pointed tool and remove spring and check valve.
2. Clean second stage housing with clean solvent and blow dry with compressed air. Check valve seat should be smooth and clean.
3. Install new check valve and spring.

4. Insert new expansion plug retainer and tap in until it bottoms.

(NOTE: Check for proper seating of valve by blowing through small end. No air should pass through.)

24. Assembling Compressor, Reservoir, and Regulator from Major Components

1. Slide piston assembly straight into first stage (large diameter) housing.
2. Install actuating arm and attach to first stage housing with arm pivot screw.
3. Connect arm tension spring to swivel arm.
4. Rotate piston in first stage housing to align elongated hole in diaphragm with vent port in first stage housing.
5. Install three compressor retaining through bolts that secure second stage housing to first stage housing. Housings will align one way only. Nuts are positioned in counterbores in second stage housing. Tighten to 28 inch-pounds. Check for free operation of valve parts.
6. Install new O-ring on second stage housing. Wash inside of reservoir in clean solvent and blow dry with compressed air. Install reservoir on second stage housing with three nuts, tightening to 28 inch-pounds. Install two reservoir retaining through bolts, tightening to 28 inch-pounds. Through bolt heads should be positioned against reservoir. Do not install through bolt that secures cover at this time.
7. Install new O-ring on regulator and secure regulator with two regulator retaining screws. Tighten to 35 inch-pounds. Service valve should be on same side as first stage housing.
8. Install new gasket and cover, and secure with cover retaining screw and new cover gasket. Tighten cover retaining screw to 35 inch-pounds. Install through bolt with head positioned against reservoir. Tighten through bolt to 28 inch-pounds.
9. Install two adapter and flexible mounts.
10. Proceed to compressor output test on car, Note 14.
11. If compressor passes output test, install as outlined in Note 21b.

GENERAL DESCRIPTION

(NOTE: The following information is not applicable to the Eldorado.)

Propeller Shaft—681, 682 and 683

A one-piece propeller shaft assembly, Fig. 4-21, is used on all 1972 styles except the Fleetwood Seventy-Five Sedan and Limousine and the Commercial Chassis. The one-piece shaft used on the Fleetwood Sixty Special Brougham is longer due to the longer wheel base on this body style.

The propeller shaft assembly is attached to the differential carrier by a double flange connection. Attachment is made to the transmission output shaft by means of an internally splined slip yoke. The slip yoke compensates for the lengthening and shortening of the shaft as required for various rear suspension travel and vehicle loading conditions.

Double Cardan constant velocity universal joints, Fig. 4-22, are used on both the front and rear of the shaft. A Double Cardan joint consists of two single joints connected by a special link yoke. A ball and socket centering device is located between the crosses to maintain their relative positions, causing each cross to operate through one half of the total angle across the joint. This results in a cancellation of vibrational impulses in the shaft, providing a smooth transfer of power.

All parts of the propeller shaft assembly are serviceable separately from the tube except the ball studs in the constant velocity universal joints, which are integral with the tube.

If a ball stud is damaged, the entire propeller shaft must be replaced as a unit. Any time a constant velocity joint is disassembled, inspect the ball stud for corrosion or disfiguration before continuing procedure.

Simple cases of unbalance (those not attributable to damaged parts or those first evidenced after component parts replacement) can be corrected with shaft installed on car.

A torsional damper, Fig. 4-26, is available as a dealer-installed item.

697-698

A two-piece propeller shaft assembly, Fig. 4-23, is used on the Fleetwood Seventy-Five Sedan and Limousine and the Commercial Chassis. Attachments at the transmission output shaft and differential carrier are identical to those of the single piece shaft. Double Cardan joints are located at each end and in the center of the prop shaft assembly.

The assembly is supported at the center by a center bearing and support and bracket assembly attached to a frame cross member.

As on the single-piece shaft, components that can be serviced separately from the tube include the bearing caps, crosses, link yokes, slip yoke assembly, rear support yoke assembly, ball stud seat assemblies, and the torsional damper.

In addition, the center bearing and the center bearing support assembly are serviceable.

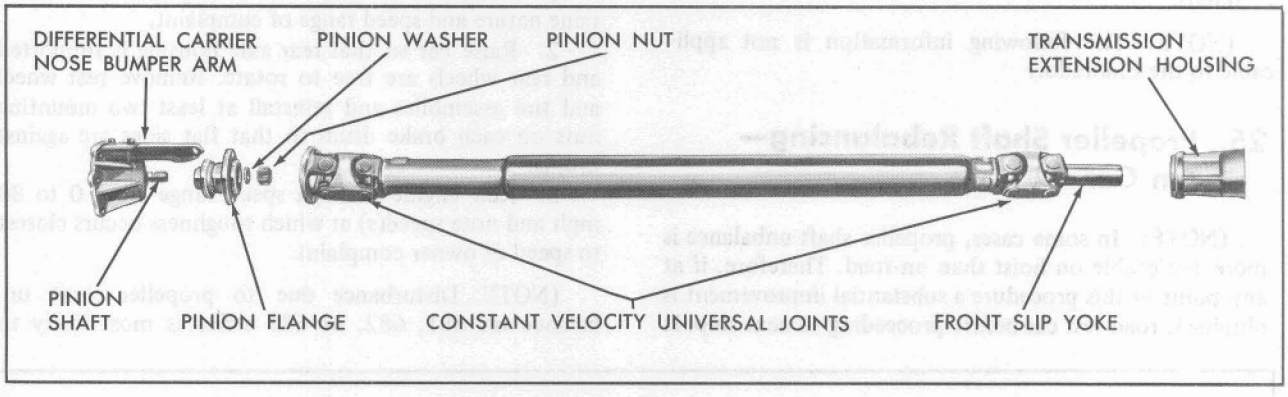


Fig. 4-21 Propeller Shaft (681-2-3)

SERVICE INFORMATION

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, suspension control arms, and transmission cooler pipes.

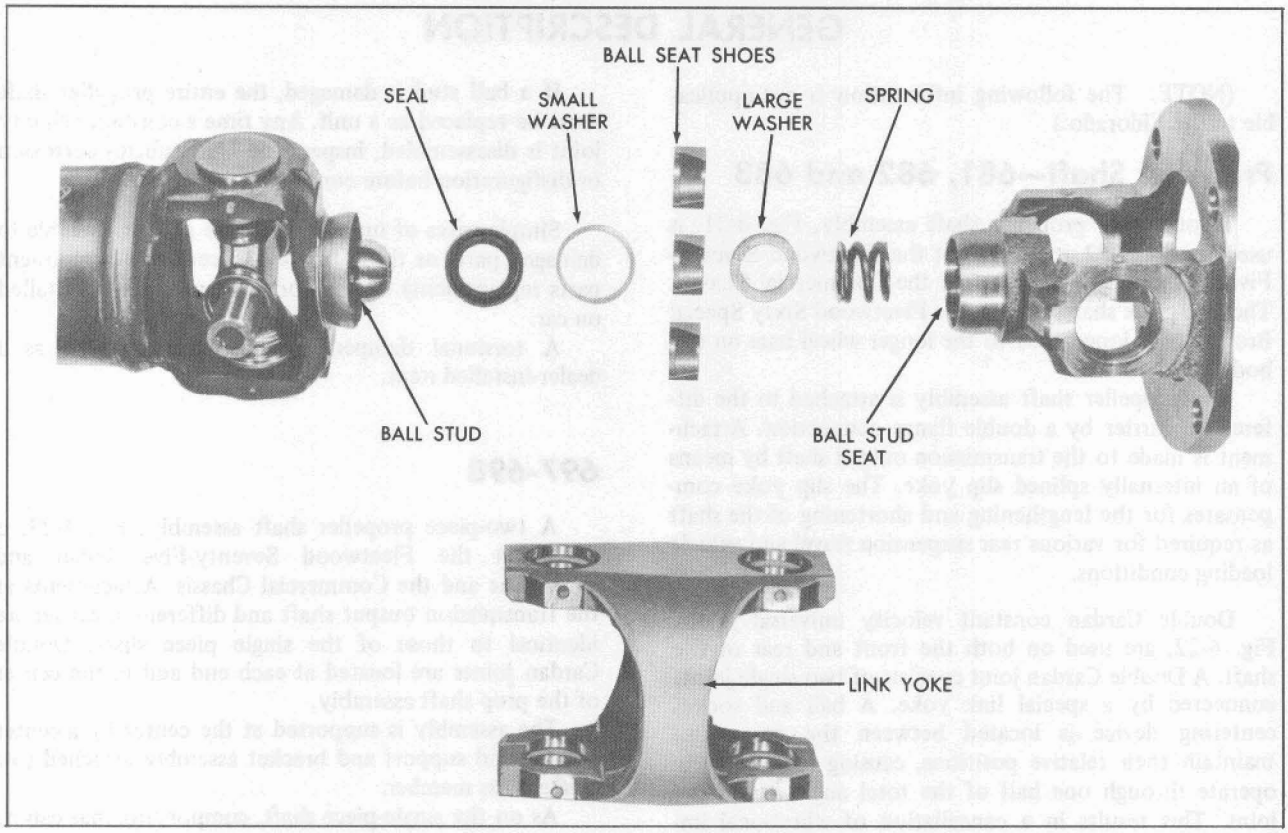


Fig. 4-22 Rear Double Cardan Joint

CAUTION: When raising rear of car, support vehicle weight at frame or axle or both. Never use control arms as contact points for hoist or jack stands.

(NOTE: The following information is not applicable to the Eldorado.)

25. Propeller Shaft Rebalancing—On Car

(NOTE: In some cases, propeller shaft unbalance is more noticeable on hoist than on road. Therefore, if at any point in this procedure a substantial improvement is obtained, road test car before proceeding to next step. It is very possible that the disturbance will not be noticeable as car is driven on the road.)

1. Road test car (with owner if possible) to determine nature and speed range of complaint.
2. Raise car so that rear axle housing is supported and rear wheels are free to rotate. Remove rear wheel and tire assemblies and reinstall at least two mounting nuts on each brake drum so that flat sides are against drums.
3. Run engine through speed range from 0 to 80 mph and note speed(s) at which roughness occurs closest to speed of owner complaint.

(NOTE: Disturbance due to propeller shaft unbalance on 681, 682, or 683 series is most likely to

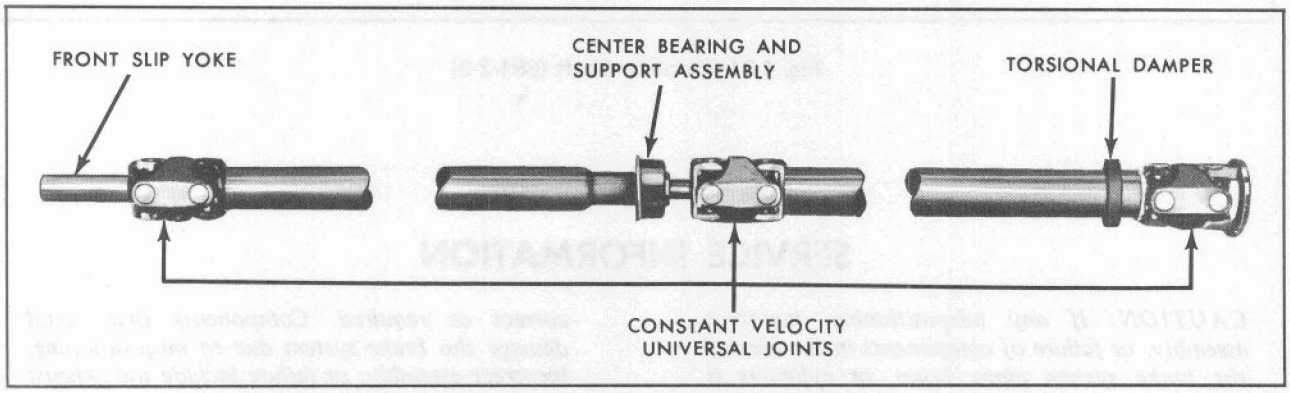


Fig. 4-23 Propeller Shaft (697-698)

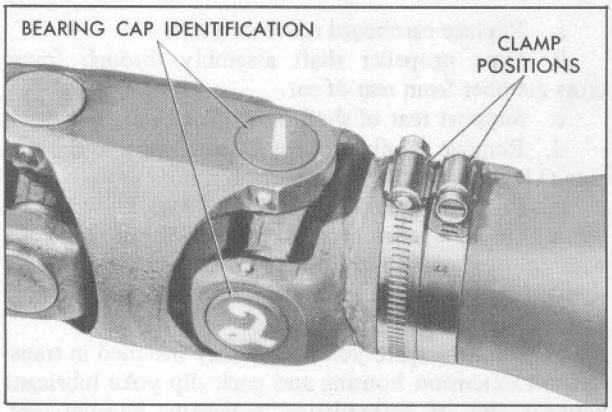


Fig. 4-24 Clamps in Position 1

occur at 30-35 mph or at freeway speeds (approximately 60 mph). On 697 and 698 styles, unbalance is likely to peak at 24-28 mph or 32-35 mph.)

4. If car is equipped with torsional damper, remove damper and re-evaluate at offending speed range.

5. On the end of the shaft suspected of unbalance, mark the constant velocity joint bearing caps with the numbers 1 through 4, Fig. 4-24.

If the location of disturbance is not readily identifiable, use the following rules of thumb:

- Series 681, 682, 682 - Test front CV joint first
- Series 697, 698 - If greatest disturbance is 20-30 mph, begin at center joint, then front joint and rear joint, if necessary. Otherwise, begin at front CV joint.

6. Install two aircraft type hose clamps (size 40 or 44) on shaft so that both clamp screws are on necked down portion of shaft and are aligned with position 1 on the first joint to be checked, Fig. 4-24.

7. Run drive line to speed of disturbance and evaluate. Indicate results on Evaluation Chart using the appropriate notations as indicated below.

EVALUATION CHART

CLAMP POSITIONS		#1	#2	#3	#4
FRONT CV JOINT	Two Clamps				
	Three Clamps				
REAR CV JOINT	Two Clamps				
	Three Clamps				

W - Worse
N - No Change
I - Improved Slightly
S - Substantial Improvement
A - Acceptable

8. Rotate clamps to position 2 and repeat Step 7. Continue evaluation until all four positions have been checked. If improvement is not obtained at any of the four locations, repeat Steps 5 through 8 on next joint to be checked.

If improvement is achieved at any location, add another clamp at same location and check for further improvement.

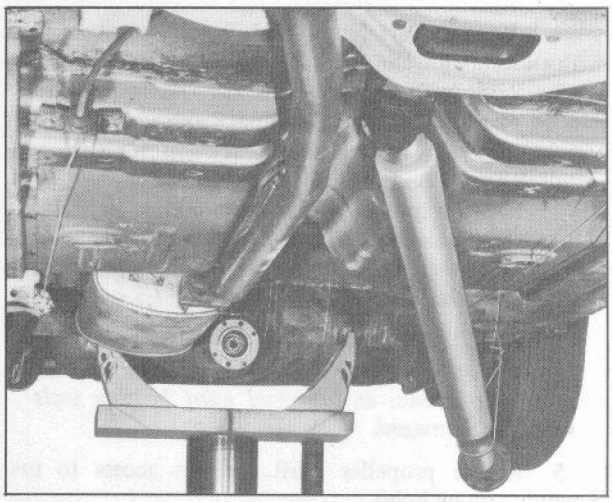


Fig. 4-25 Supporting Propeller Shaft

9. When best possible improvement is achieved, road test car. Often, roughness noticeable on hoist disappears when car is on road.

10. Make sure position of clamps is such that clearance with underbody and other parts is assured under all operating conditions. Tighten clamps securely. Clamps are to be left on car as permanent fixtures.

26. Propeller Shaft Assembly (681-2-3)

a. Removal

1. Raise car on hoist with transmission in Neutral.

2. Remove two accessible rear universal joint flange attaching screws.

3. Rotate propeller shaft to gain access to remaining two screws and remove screws and lockwashers.

CAUTION: Before *removing the two remaining flange screws, install support chain as shown in Fig. 4-25. Do not permit propeller shaft to be supported by the front constant velocity universal joint only.*

4. Remove propeller shaft by pushing shaft forward so that the rear universal joint flange clears pinion flange, then remove shaft by pulling rearward to disengage slip yoke.

5. Install a clean cardboard shipping cover, or similar protective device, on front slip yoke to protect the slip yoke.

6. Install spare yoke into transmission extension housing to prevent loss of oil.

b. Installation

1. Remove any nicks, burrs, or dirt from differential carrier pinion flange and from mating flange on rear constant velocity joint.

2. Remove cardboard cover and clean slip yoke, if necessary, avoiding the use of anything that may scratch or damage yoke. Lubricate I.D. of slip yoke with approximately two tablespoons of propeller shaft slip

yoke lubricant, Part No. 1050169, and lubricate O.D. with transmission fluid.

3. Remove spare yoke previously installed in transmission extension housing, and pack slip yoke lubricant between lips of transmission extension housing seal. Install slip yoke on transmission output shaft.

4. Position propeller shaft on pinion flange, and connect rear universal joint flange to pinion flange with two attaching screws and lockwashers. Torque screws to 70 foot-pounds. *(See CAUTION on Page 4-3.)*

CAUTION: Do not use a pry bar or heavy tool to hold propeller shaft when tightening flange attaching screws, as universal joint bearing seals would be damaged.

5. Rotate propeller shaft to gain access to two remaining screw holes.

6. Install remaining two attaching screws and lockwashers at rear universal joint flange. Torque screws to 70 foot-pounds and remove support chain. *(See CAUTION on Page 4-3.)*

7. Lower car on hoist.

8. Check transmission oil level as described in Section 7, Note 6.

27. Propeller Shaft Assembly—697 and 698

a. Removal

1. Raise car on hoist with transmission in Neutral.

2. Remove two accessible rear universal joint flange attaching screws and lockwashers.

3. Install support wire or chain, Fig. 4-25.

4. Rotate propeller shaft to gain access to remaining two screws and remove screws and lockwashers.

5. Pull rear half of shaft forward to clear pinion flange and rest shaft on support chain, Fig. 4-25.

6. Remove the two center bearing support to frame bolts and nuts.

7. Slide propeller shaft rearward until front slip yoke comes off of transmission output shaft and install cardboard shipping cover, or similar protective device, on front yoke. The cardboard cover will prevent nicking of the yoke during removal as well as keeping the yoke as clean as possible.

8. On 697 series cars, lower propeller shaft from chassis. On 698 series, withdraw propeller shaft through frame cross member, removing it from the rear.

9. Install a spare yoke into transmission extension housing to prevent oil loss.

b. Installation

1. Remove any nicks, burrs, dirt, or rust from differential pinion flange face and from face of mating flange at rear constant velocity universal joint.

2. Remove cardboard cover and clean slip yoke, if necessary, avoiding the use of anything that may scratch or damage yoke. Lubricate I.D. of slip yoke with approximately two tablespoons of propeller shaft slip yoke lubricant, Part No. 1050169.

3. On 698 series cars, perform the following procedure:

a. Replace cardboard cover on yoke.

b. Slipe propeller shaft assembly through frame cross member from rear of car.

c. Support rear of shaft on wire or chain, Fig. 4-25.

d. Remove cardboard cover from yoke and lubricate O.D. of yoke with transmission fluid.

e. Proceed to Step 5.

4. On 697 series cars, lubricate O.D. of slip yoke with transmission fluid. Insert rear portion of propeller shaft in supporting wire or chain, Fig. 4-25, and support front section of shaft by hand.

5. Remove spare yoke previously installed in transmission extension housing and pack slip yoke lubricant between lips of transmission extension housing seal. Install front slip yoke on transmission output shaft.

6. Install two bolts and nuts securing center bearing support to frame cross member, tightening to 16 foot-pounds.

7. Position propeller shaft and connect rear universal joint flange to pinion flange with two attaching screws and lockwashers. Torque screws to 70 foot-pounds. *(See CAUTION on Page 4-3.)*

CAUTION: Do not use a pry bar or heavy tool to hold propeller shaft when tightening flange attaching screws, as universal joint bearing seals would be damaged.

8. Rotate propeller shaft to gain access to two remaining screw holes.

9. Install remaining two attaching screws and lockwashers at rear universal joint flange. Torque screws to 70 foot-pounds and remove support chain. *(See CAUTION on Page 4-3.)*

10. Lower car on hoist.

11. Check transmission oil level as described in Section 7, Note 6.

28. Propeller Shaft Torsional Damper—697-698

a. Removal

1. Raise car with transmission in Neutral.

2. Remove one of two hex head screws securing split ring torsional damper to front of propeller shaft, Fig. 4-26.

3. Rotate propeller shaft to gain access to remaining screw.

4. Remove remaining screw and remove torsional damper from propeller shaft.

b. Installation

1. Position torsional damper on propeller shaft and install one screw. Tighten screw to 20 foot-pounds.

2. Rotate propeller shaft to gain access to remaining screw hole.

3. Install remaining screw. Tighten screw to 20 foot-pounds.

4. After both torsional damper screws have been installed, recheck torque on both screws. It may be necessary to tighten the first screw a little more to obtain the proper torque.

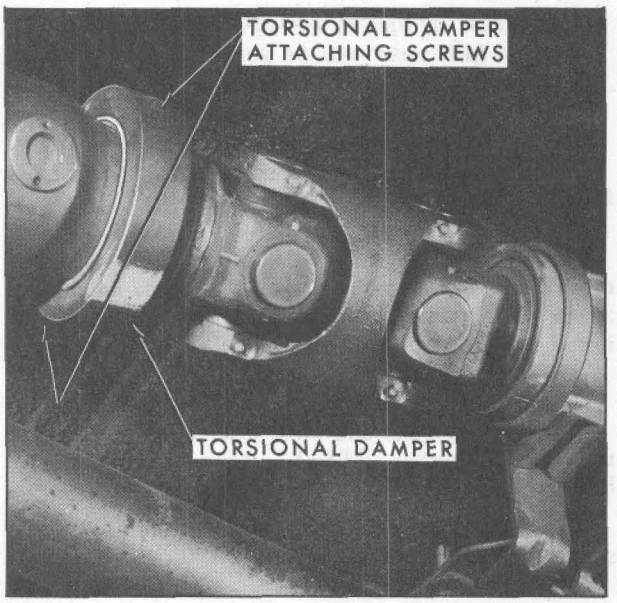


Fig. 4-26 Propeller Shaft Torsional Damper

5. Lower car.

(NOTE: The torsional damper is machined as an assembly. Use extreme care to prevent mixing halves.)

29. Universal Joint Cross

(NOTE: If both crosses are to be removed, perform this procedure first on slip yoke (or support yoke) cross, then repeat procedure for inner cross beginning with Step 5.)

a. Removal

1. Obtain stand equal in height to arbor press anvil and position stand near press.

2. Place Yoke Support, J-22222-1, on press with small end up.

(NOTE: A support tool equivalent to J-22222-1 can be fashioned by welding a 1" piece of 1¼"-diameter pipe to a piece of flat stock, Fig. 4-27.)

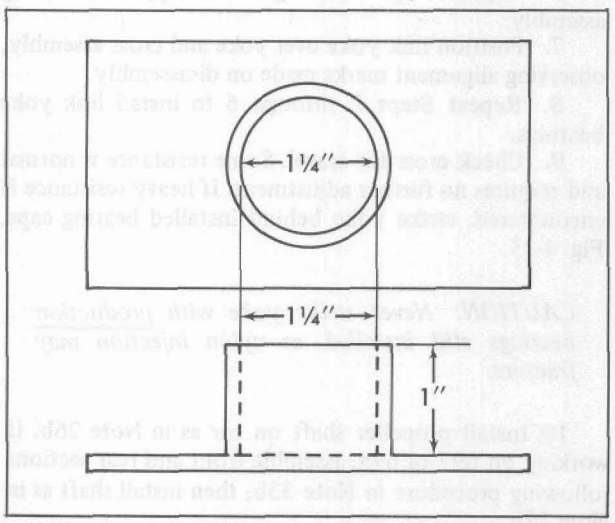


Fig. 4-27 Support Tool Dimensions

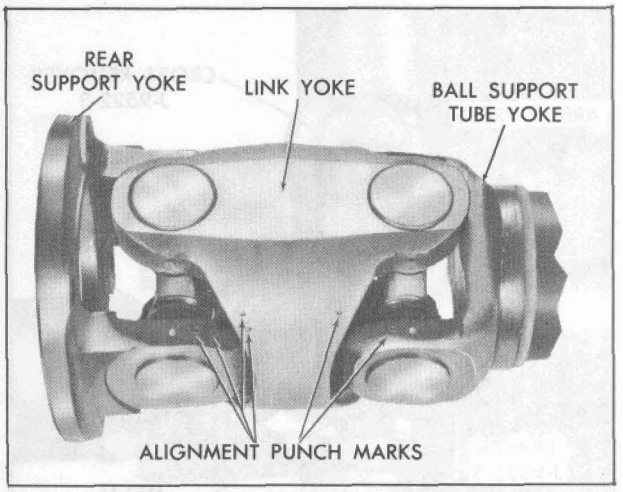


Fig. 4-28 Alignment Marks on Yokes

3. Scribe or punch alignment marks on all yokes for proper orientation on reassembly, Fig. 4-28.

4. Remove propeller shaft from car as described in Note 26a. If working on 697 or 698, perform instead procedure in Note 27a, then separate front and rear sections according to Note 33a.

5. Position shaft on stand and arbor press so that one link yoke bearing cap is over hole in Yoke Support, J-22222-1.

(NOTE: Bearings in link yoke must be removed before remaining bearings.)

6. If working on joint that has been serviced previously, remove snap rings from grooves in bearings.

7. Install Cross Remover, J-9522-3, over link yoke, engaging sides of bearings, Fig. 4-29. Use press to shear nylon injection of link yoke bearing and press bearing out of yoke as far as possible.

(NOTE: When press is operated, joint will angulate, causing opposite end of shaft to rise. This movement is

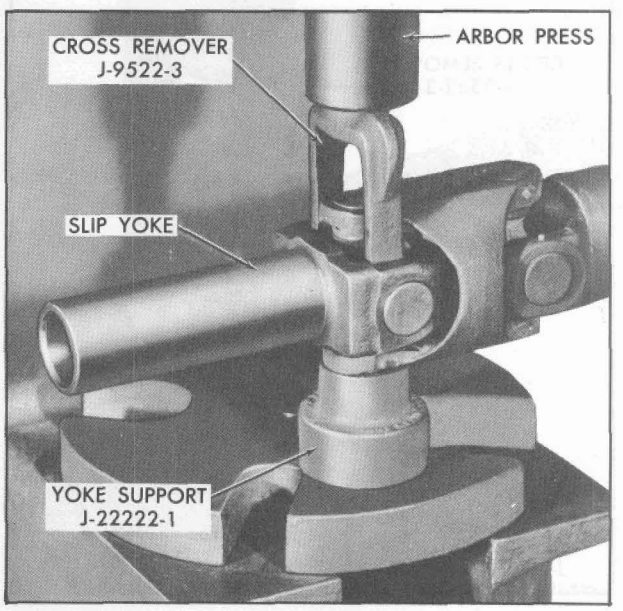


Fig. 4-29 Removing Bearing Caps

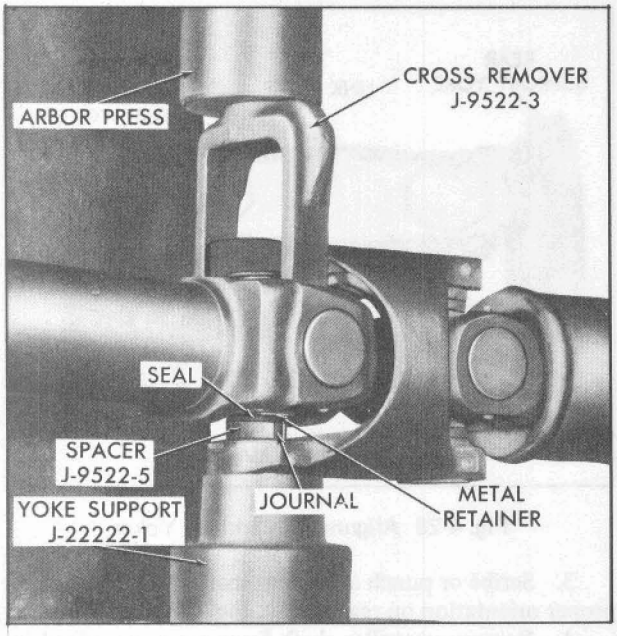


Fig. 4-30 Position of Spacer on Cross

necessary to remove bearings. Use other hand to support and guide shaft in its upward movement, and to lower shaft gently when press lever is released.)

8. Release press and remove Cross Remover, J-9522-3. Lift up on cross and position Spacer, J-9522-5, around lower journal, Fig. 4-30.

(NOTE: If bearing did not come out far enough to insert Spacer, J-9522-5, turn shaft over in press and repeat Step 7 to partially remove opposite link yoke bearing. Then install Spacer and proceed to Step 9.)

9. Position Cross Remover, J-9522-3, and continue pressing link yoke bearing from yoke.

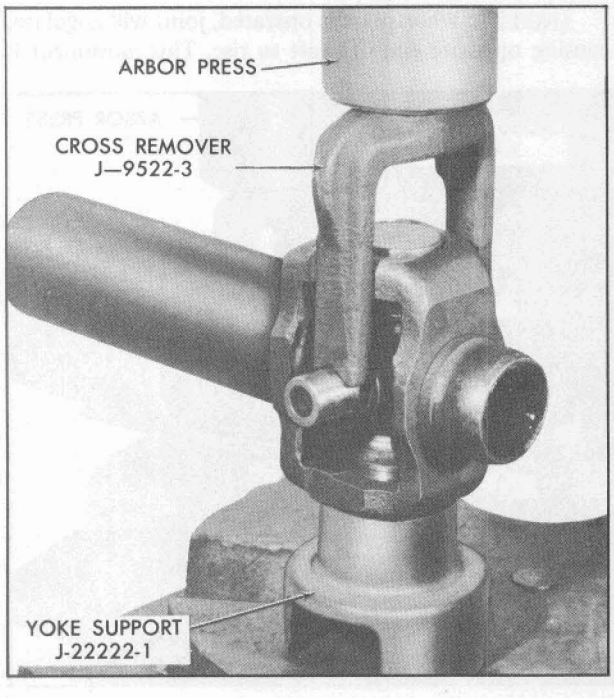


Fig. 4-31 Removing Cross

CAUTION: If Spacer, J-9522-5, is mispositioned, I.D. of link yoke will be gouged, necessitating replacement of link yoke.

10. Repeat Steps 8 and 9 for other link yoke bearing.

11. Separate slip yoke (or support yoke) and cross from link yoke.

12. Examine ball stud on shaft for rust, corrosion, distortion, or wear pattern. If any of these conditions exists, shaft cannot be serviced. Discard all parts and install new propeller shaft assembly.

13. Position yoke and cross assembly on press and use Cross Remover, J-9522-3, to remove remaining bearings, Fig. 4-31.

(NOTE: Spacer, J-9522-5, is not necessary at this stage of procedure.)

b. Installation

Whenever a universal joint is removed, a new service kit must be installed, as production universal joints have no snap ring grooves. Install only complete universal joint repair kits. Kits include a new cross, four bearing assemblies, retainers and seals, and four snap rings, Fig. 4-32.

1. Insert cross into yoke.
2. Insert one bearing assembly by hand.

CAUTION: Make certain all needles are properly seated in bearing. If any needles are missing or mispositioned, early failure will result.

3. Adjust position of cross so that one leg of cross is all the way into bearing. Make sure bearing is not cocked in yoke.
4. Maintain position of cross in bearing to keep needles seated, and firmly tap bearing into yoke, Fig. 4-33, until snap ring groove is exposed.
5. Install snap ring in groove in bearing, Fig. 4-34.
6. Repeat Steps 2 through 5 for opposite bearing assembly.
7. Position link yoke over yoke and cross assembly, observing alignment marks made on disassembly.
8. Repeat Steps 2 through 6 to install link yoke bearings.
9. Check cross for travel. Some resistance is normal and requires no further adjustment. If heavy resistance is encountered, strike yoke behind installed bearing caps, Fig. 4-35.

CAUTION: Never strike yoke with production bearings still installed, as nylon injection may fracture.

10. Install propeller shaft on car as in Note 26b. If working on 697 or 698, assemble front and rear sections following procedure in Note 33b, then install shaft as in Note 27b.
11. Rebalance shaft on car as explained in Note 25.

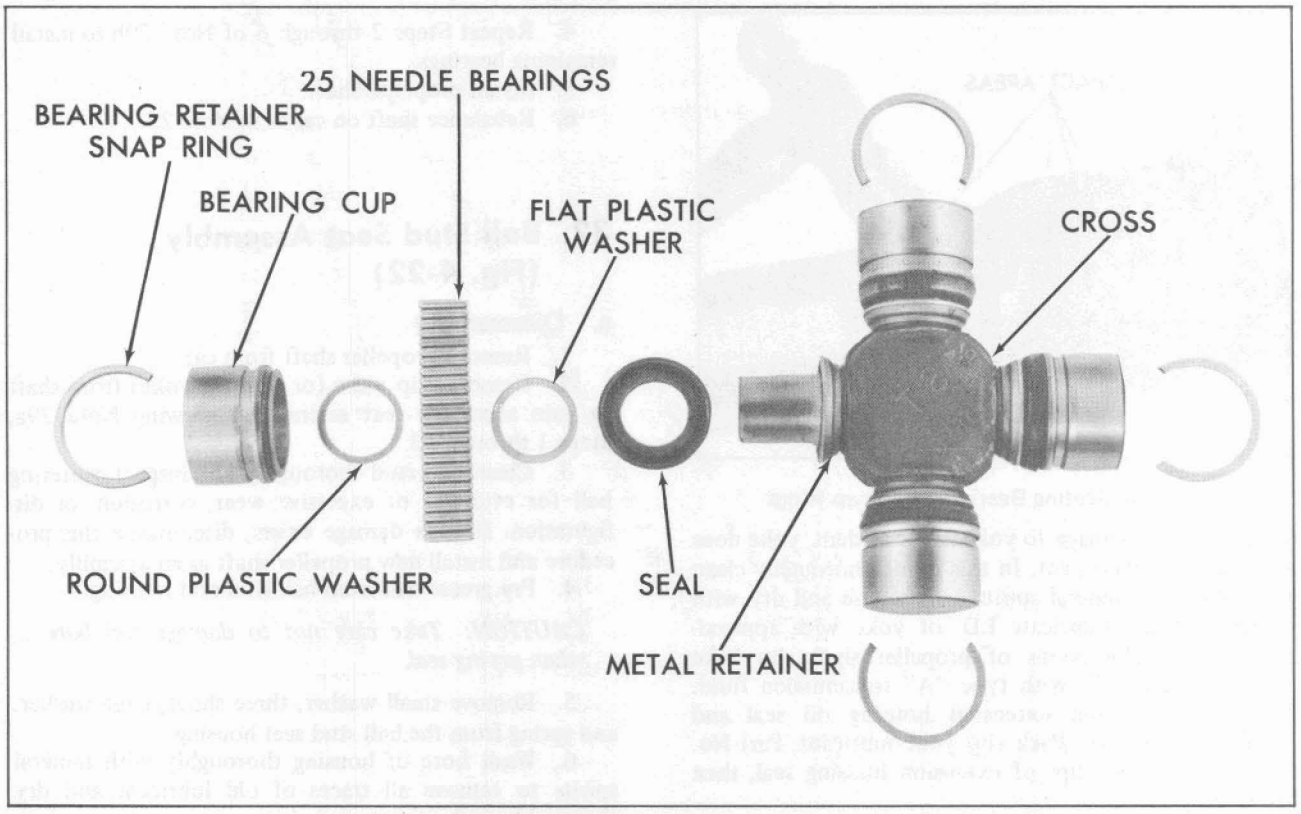


Fig. 4-32 Universal Joint Service Kit

30. Slip Yoke or Rear Support Yoke

a. Removal

1. Remove propeller shaft from car as described in Note 26a. If working on 697 or 698, perform instead procedure in Note 27a, then separate front and rear sections according to Note 33a.

2. If slip yoke is to be replaced, inspect outer surface for rust, scratches, or gouges. Check internal splines

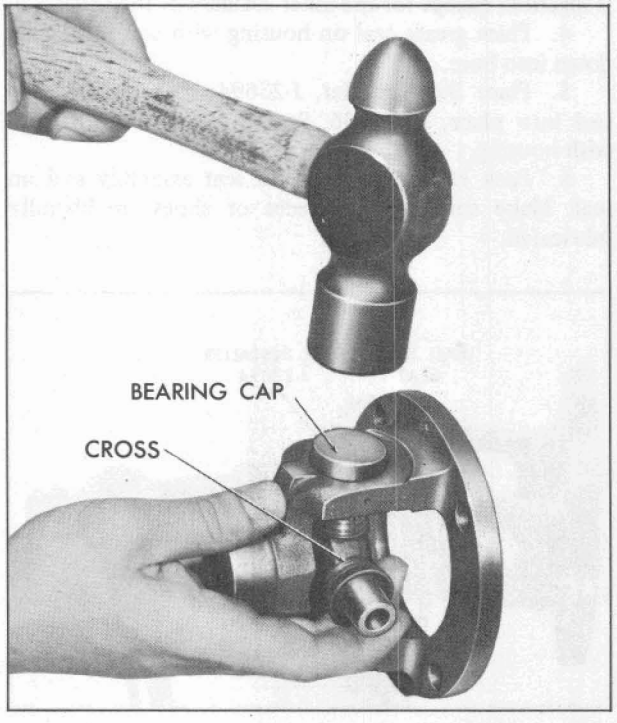


Fig. 4-33 Installing Bearing Caps

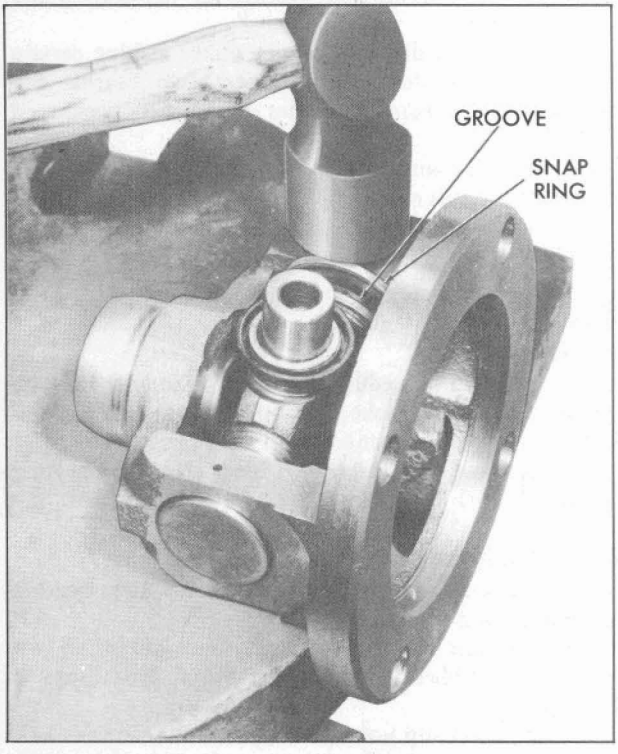


Fig. 4-34 Installing Snap Ring

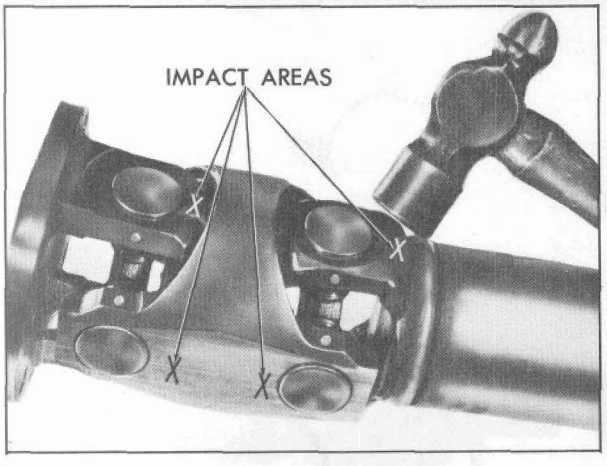


Fig. 4-35 Seating Bearings and Snap Rings

for damage. If damage to yoke is not evident, yoke does not require replacement. In this event, thoroughly clean slip yoke with mineral spirits or kerosene and dry with compressed air. Lubricate I.D. of yoke with approximately two tablespoons of propeller shaft slip yoke lubricant, and O.D. with type "A" transmission fluid. Inspect transmission extension housing oil seal and replace if necessary. Pack slip yoke lubricant, Part No. 1050169, between lips of extension housing seal, then install prop shaft.

3. Remove yoke from shaft following procedure in Note 29a, Steps 1 through 12.

b. Installation

1. Obtain yoke replacement kit. Kit consists of a new yoke, a cross with two bearing caps installed and nylon-injected, a ball stud seat assembly installed and lubricated, two additional bearing cap assemblies, and two snap rings.

2. Inspect ball stud seat in yoke, making certain seat is liberally lubricated. Inspect two bearing cap assemblies to be sure all needles are properly positioned and lubricated.

3. Position link yoke over cross and install bearings, observing procedure in Note 29b, Steps 2 through 6.

4. Install propeller shaft on car.

5. Rebalance shaft on car as in Note 25.

31. Link Yoke

a. Removal

1. Perform procedure of Note 29a, Steps 1 through 12, to remove slip yoke (or support yoke) cross from link yoke and to inspect ball stud for damage.

2. Remove link yoke from inner cross by repeating Steps 5 through 10 of Note 29a.

b. Installation

1. Obtain a new link yoke, four new bearing assemblies, and four snap rings.

2. Position link yoke on inner cross and install two bearing assemblies by following Note 29b, Steps 2 through 6.

3. Position slip yoke (or support yoke) cross in link yoke, orienting with tube yoke according to marks made on disassembly.

4. Repeat Steps 2 through 6 of Note 29b to install remaining bearings.

5. Install propeller shaft.

6. Rebalance shaft on car as in Note 25.

32. Ball Stud Seat Assembly (Fig. 4-22)

a. Disassembly

1. Remove propeller shaft from car.

2. Remove slip yoke (or support yoke) from shaft to gain access to seat assembly, following Note 29a, Steps 1 through 12.

3. Clean ball stud thoroughly and inspect centering ball for evidence of excessive wear, corrosion, or disfiguration. If such damage exists, discontinue this procedure and install new propeller shaft as an assembly.

4. Pry grease seal from ball stud seat housing.

CAUTION: Take care not to damage seal bore when prying seal.

5. Remove small washer, three shoes, large washer, and spring from the ball stud seat housing.

6. Wash bore of housing thoroughly with mineral spirits to remove all traces of old lubricant and dry thoroughly with compressed air.

b. Assembly

1. Obtain ball stud seat kit, Fig. 4-22, and lubricant.

2. Liberally grease the I.D. of the seat housing.

3. Insert spring, large washer, three shoes, and small washer into housing, thoroughly greasing each part as it is inserted, except for the inner surfaces of the shoes.

4. Place grease seal on housing with seal lips facing down into bore.

5. Place Seal Installer, J-23694, over seal and tap seal into place, Fig. 4-36. Seal is installed when flush with housing.

6. Pack remaining grease in seat assembly and on seal. Make sure inner surfaces of shoes are liberally lubricated.

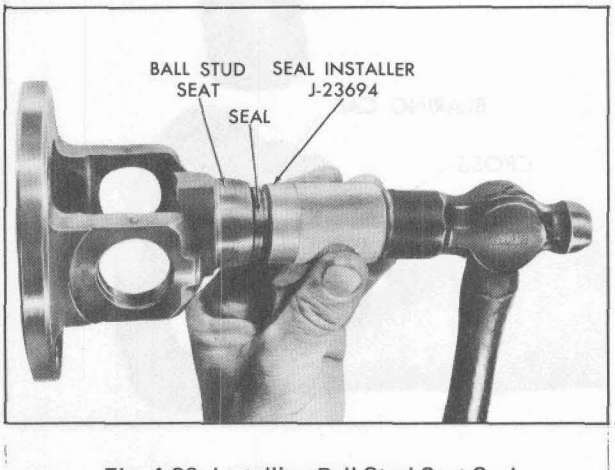


Fig. 4-36 Installing Ball Stud Seat Seal

7. Position yoke and cross assembly in link yoke and install bearings, observing procedure of Note 29b, steps 2 through 6.

8. Install propeller shaft.

9. Rebalance shaft on car as in Note 25.

33. Front Section—697 and 698

a. Disassembly

1. Remove propeller shaft assembly as described in Note 27a.

2. Pry up center bearing lock retainer, Fig. 4-37.

3. Back off center bearing retaining nut, using Center Bearing Retaining Nut Remover and Installer, J-21009, and separate front and rear propeller shafts by sliding front shaft off center slip yoke.

4. Remove and discard center bearing lock retainer if damaged.

5. Remove center slip yoke seal, split washer, and center bearing retaining nut from slip yoke. Inspect for damage or excessive wear.

b. Assembly

1. Clean spline of center slip yoke.

2. Install center bearing retaining nut on slip yoke with threaded end toward front propeller shaft.

3. Install split washer, being sure to slide washer securely against inner shoulder of retaining nut.

4. Slide slip yoke seal over center slip yoke and into retaining nut.

5. Install new center bearing lock retainer on center slip yoke.

6. Coat inner spline of front propeller shaft and spline of center slip yoke with center bearing slip yoke lubricant, Part No. 1050191.

7. Align wire clip on end of center slip yoke with missing land on inner spline of front shaft and slide center slip yoke into front propeller shaft spline.

8. Tighten center bearing retaining nut to 55 foot-pounds using Center Bearing Retaining Nut Remover and Installer, J-21009, and a torque wrench, Fig. 4-38.

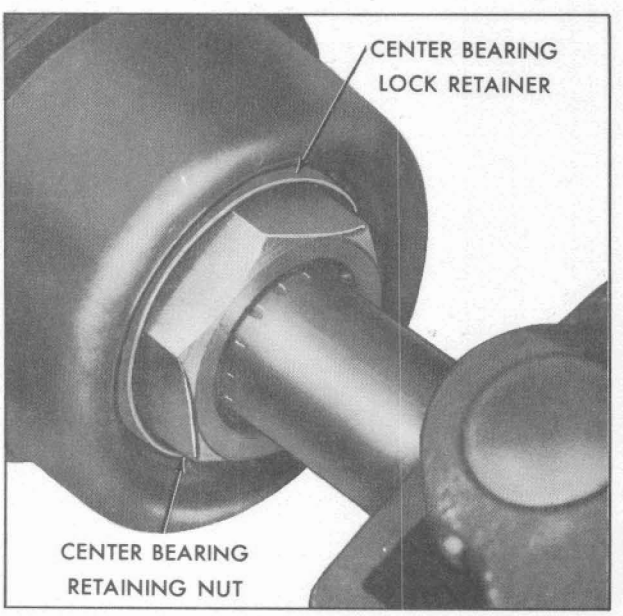


Fig. 4-37 Propeller Shaft Retainer

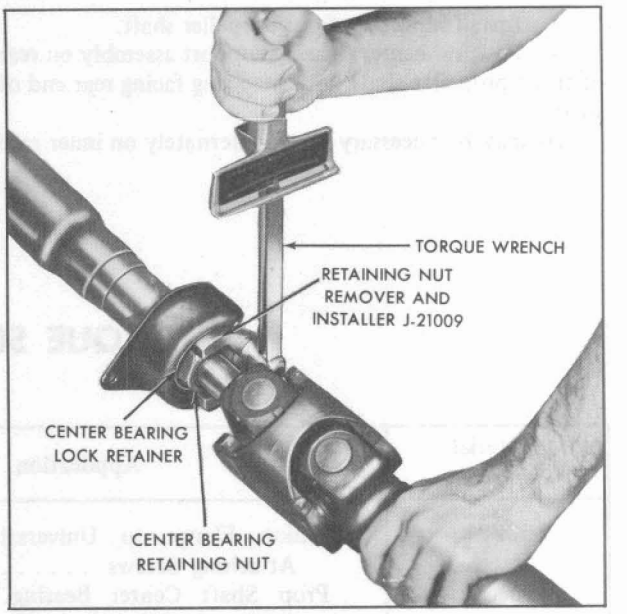


Fig. 4-38 Tightening Center Bearing Retaining Nut

CAUTION: Particular care should be taken in application of torque wrench and installer tool, to prevent over-torquing the nut. Hold torque wrench perpendicular to installer tool to cancel off-set error on torque reading.

9. Bend edge of center bearing lock retainer in two places to lock center bearing retaining nut.

10. Install propeller shaft assembly as described in Note 27b.

34. Center Bearing—697 and 698

a. Removal

1. Remove propeller shaft assembly as described in Note 27a.

2. Disassemble front and rear propeller shafts as described in Note 33a.

3. Remove center bearing support and bracket assembly from front propeller shaft by tapping on front side of assembly with a soft head hammer or through a block of wood.

4. Remove slinger from end of propeller shaft.

5. Pry out snap ring from open side of bearing retainer and remove bearing from support bracket by tapping lightly from rear with a soft head hammer, or through a block of wood.

b. Installation

1. Install bearing into bearing retainer, pressing on outer race of bearing only. Use care not to damage bearing or support. Secure bearing in retainer with snap ring.

2. Pack front and rear face of center bearing with artic #5 grease or other heavy duty lubricant, such as water pump grease.

3. Install slinger on front propeller shaft.

4. Position center bearing support assembly on rear of front propeller shaft with snap ring facing rear end of shaft.

(It may be necessary to tap alternately on inner race of bearing with a brass drift to permit clearance for installing retaining nut.)

5. Assemble front and rear propeller shafts as described in Note 33b.

6. Install propeller shaft assembly as described in Note 27b.

TORQUE SPECIFICATIONS

Material No.	Application	Size	Foot-Pounds
300-M	Pinion Flange to Universal Joint Flange Attaching Screws	7/16-20	70*
Special	Prop Shaft Center Bearing Retaining Nut (697 and 698)	1-9/16-18	55
300-M	Center Bearing Support Bolts (697 and 698)	5/16-24	16
300-M (Special)	Propeller Shaft Torsional Damper Screws	5/16-18	20

NOTE: Refer to back of manual, Page 16-1, for bolt and nut markings and steel classifications.

CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

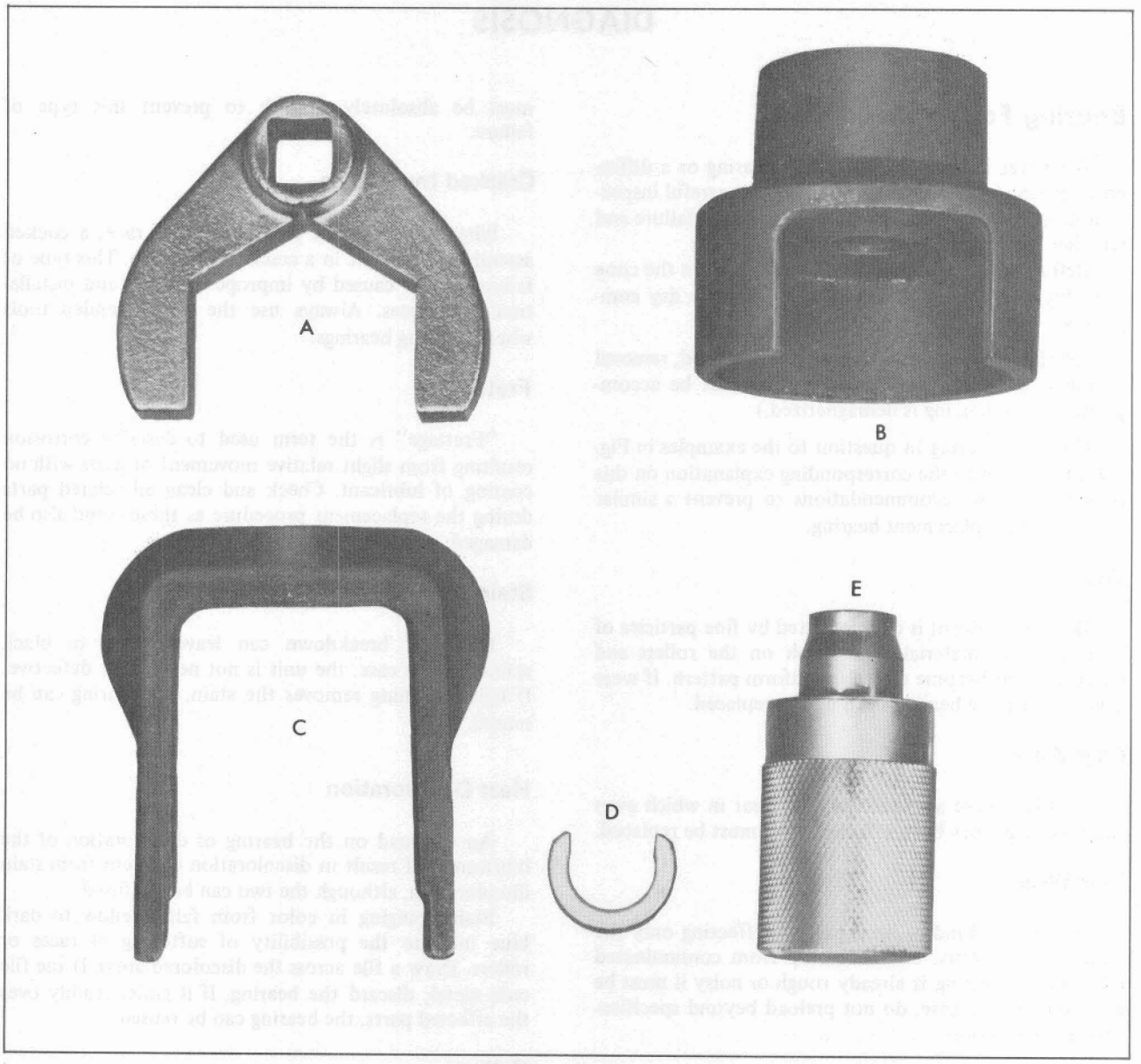


Fig. 4-39 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-21009	Center Bearing Retaining Nut Remover and Installer	D	J-9522-5	Spacer
			E	J-23694	Ball Stud Seat Seal Installer
B	J-22222-1	Yoke Support			
C	J-9522-3	Cross Remover			

DIAGNOSIS

Bearing Failure Conditions

Whenever a front or rear wheel bearing or a differential pinion or side bearing is removed, a careful inspection must be made to determine the cause of failure and whether any related parts have been damaged.

Before diagnosing a bearing problem, clean the cone assembly thoroughly in solvent and allow to dry completely.

(NOTE: If bearing has become magnetized, removal of metal particles from inside cage cannot be accomplished unless bearing is demagnetized.)

Compare bearing in question to the examples in Fig. 4-40, then refer to the corresponding explanation on this page and follow recommendations to prevent a similar failure in the replacement bearing.

Wear

Bearing lubricant is contaminated by fine particles of some abrasive material. The finish on the rollers and outer race has become dulled in uniform pattern. If wear is very minor the bearing need not be replaced.

Cage Wear

This is a more advanced case of wear in which even the roller cage has been affected. Unit must be replaced.

Step Wear

A different kind of wear pattern, affecting only the ends of the rollers, could develop from contaminated lubricant. If bearing is already rough or noisy it must be replaced. In any case, do not preload beyond specification on installation.

Indentations

Surface depressions or pits in the races or rollers are caused by hard particles of foreign material. If condition is at least as advanced as that shown in the example, discard bearing and outer race.

Regardless of whether or not replacement is necessary, if any bearing shows signs of indentation or of wear on race, rollers, or cage, the lubricant must be completely removed from the bearing assembly and all associated parts before refilling or repacking. All seals must be examined very carefully for damage that could admit contaminants. If these precautions are not followed, an identical failure could result.

Misalignment

The roller and cage assembly in this example is cocked with respect to the outer race. Check for small burrs or foreign material lodged between bearing and outer race or between race and housing. These surfaces must be absolutely smooth to prevent this type of failure.

Cracked Inner Race

When the press fit is at the inner race, a cocked assembly will result in a cracked inner race. This type of failure can be caused by improper removal and installation techniques. Always use the recommended tools when servicing bearings.

Frettage

"Frettage" is the term used to describe corrosion resulting from slight relative movement of parts with no coating of lubricant. Check and clean all related parts during the replacement procedure as these could also be damaged.

Stain Discoloration

Lubricant breakdown can leave brown or black stains. In this case, the unit is not necessarily defective. If light polishing removes the stain, the bearing can be reused.

Heat Discoloration

An overload on the bearing or deterioration of the lubricant will result in discoloration different from stain discoloration, although the two can be confused.

Stains ranging in color from faint yellow to dark blue indicate the possibility of softening of races or rollers. Draw a file across the discolored areas. If the file cuts metal, discard the bearing. If it glides readily over the affected parts, the bearing can be reused.

Galling

Metal smears on roller ends render bearings unusable. When installing new bearing, be certain that bearing is properly adjusted and that correct lubricant is used. Conduct a very careful examination of seals. This condition is easily caused when lubricant is allowed to escape.

Bent Cage

This kind of damage results from simple mishandling. Bearings are very vulnerable to forces other than those that they were designed to handle. A dent even as minor as the one pictured will ruin a bearing.

Always use a piece of cardboard or other soft covering on workbench when handling bearing parts.

Brinelling

A severe impact on a bearing or vibration while the unit is not rotating causes the rollers to dent the race

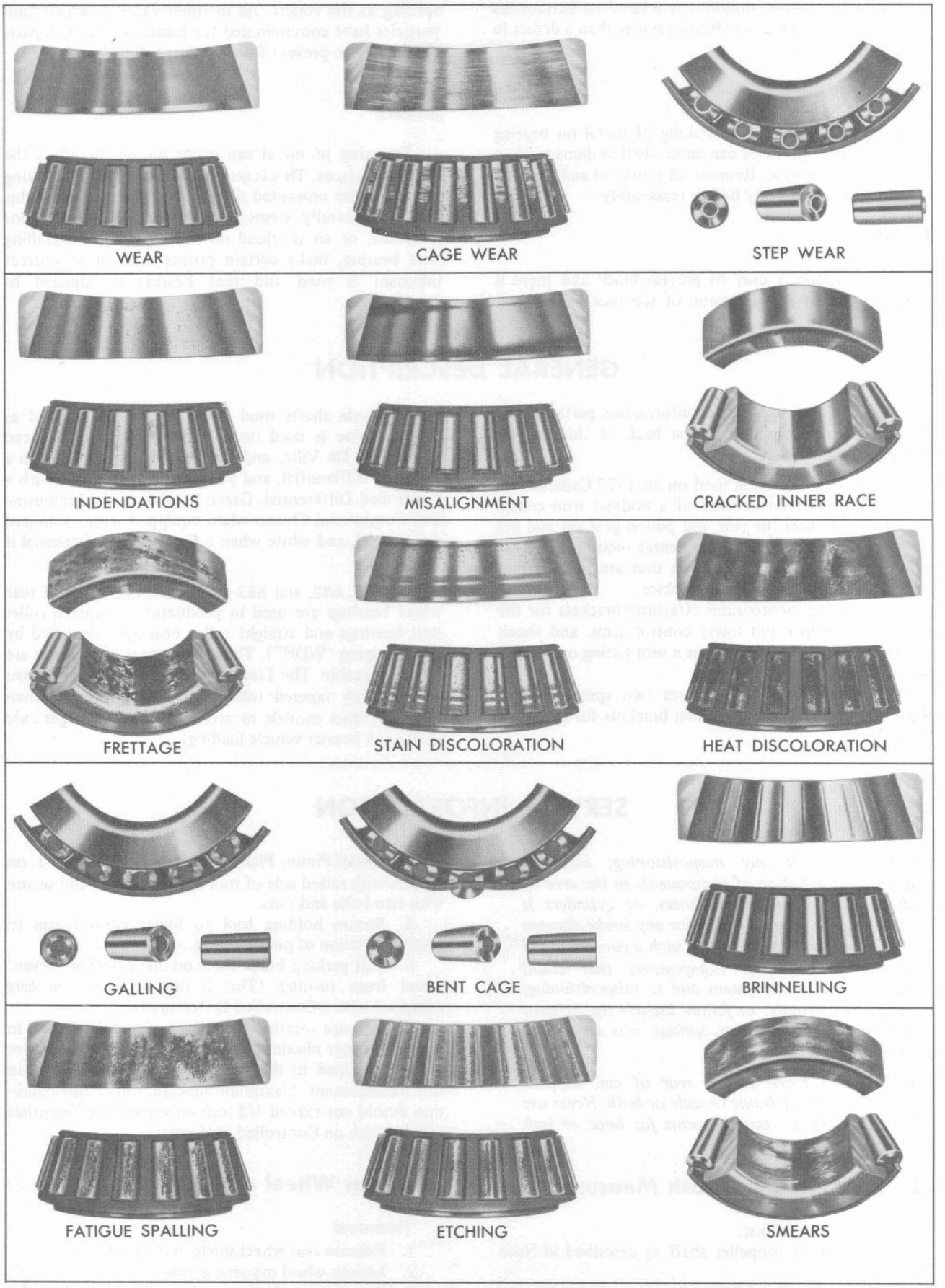


Fig. 4-40 Bearing Failure Conditions

surface. Often, this condition is related to extraneous circumstances (such as a collision) rather than a defect in the vehicle.

Fatigue Spalling

Fatigue spalling is the flaking of metal on bearing surfaces. These particles can cause further damage when car is back in service. Remove all lubricant and clean all related parts completely before reassembly.

Etching

Bearing appears gray or grayish black and there is some erosion of surface metal of the race at the same spacing as the rollers. As in other cases in which hard particles have contaminated the lubricant, clean all parts thoroughly to prevent future damage. Check seals.

Smears

Smearing of metal can occur on any or all of the bearing surfaces. This is generally due to the overheating related to the unwanted slippage between parts, and this slippage generally stems from either a loose fit, poor lubricant, or an overload on the unit. When installing new bearing, make certain proper amount of correct lubricant is used and that bearing is adjusted to specification.

GENERAL DESCRIPTION

(NOTE: Rear axle service information pertaining to the Eldorado is covered at the back of this section beginning on Page 4-40.)

The rear axle housing used on all 1972 Cadillac cars except the Eldorado consists of a nodular iron center section that houses the ring and pinion gear set and the differential. In addition to the center section, there are two tube and bracket assemblies that are pressed into the center section and welded in place.

The housing incorporates attaching brackets for the rear springs, upper and lower control arms, and shock absorbers. The axle housing has a vent fitting on the left side to relieve internal pressure.

The Commercial Chassis uses two spring pads in place of the two spring attaching brackets for attaching the leaf springs.

The axle shafts used in 1972 are color coded as follows: blue is used on the Fleetwood Sixty Special Brougham, De Ville, and Calais when equipped with a standard differential, and yellow when equipped with a Controlled Differential. Green is used on the Limousine and Commercial Chassis when equipped with a standard differential, and white when a Controlled Differential is used.

On 681, 682, and 683 series cars, two types of rear wheel bearings are used in production – tapered roller unit bearings and straight roller bearings (identified by the stamping "NDH"). These two types of bearings are interchangeable. The Limousine and Commercial Chassis employ only tapered roller unit bearings (larger than those of other models to accommodate the larger axle shafts and heavier vehicle loading).

SERVICE INFORMATION

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, and suspension control arms.

CAUTION: When raising rear of car, support vehicle weight at frame or axle or both. Never use control arms as contact points for hoist or jack stands.

35. Rear Axle Backlash Measurement

1. Place car on hoist.
2. Disconnect propeller shaft as described in Note 26a.
3. Install Spacers, J-21044-5, over unthreaded holes of pinion flange.
4. Install Pinion Flange Holding Tool, J-8614-1, on spacers with raised side of tool against spacers and secure with two bolts and nuts.
5. Secure holding tool to lower control arm to prevent rotation of pinion flange.
6. Pull parking brake cable on one wheel to prevent wheel from turning. (This is not necessary on cars equipped with a Controlled Differential).
7. Measure rotation (backlash) of opposite wheel in inches of outer circumference of tire tread. A stiff wire pointer fastened to the fender or car frame will aid in this measurement. Maximum backlash under this condition should not exceed 1/2 inch on standard differentials and 1/8 inch on Controlled Differentials.

36. Rear Wheel and Brake Drum

a. Removal

1. Remove rear wheel shield and wheel disc.
2. Loosen wheel mounting nuts.
3. Raise rear end of car and place jack stands under rear frame rails.

4. Remove wheel mounting nuts and remove wheel. (Remove wheel spacer on 698 series vehicles.)

5. Remove push nut securing brake drum to axle shaft flange. (Push nut is not used on 698 series cars.)

6. Remove brake drum.

b. Installation

1. Install brake drum.

2. Install one push nut securing brake drum to axle shaft flange, except on 698 series vehicles. (Install wheel spacer on 698 series vehicles.)

3. Install wheel and replace wheel mounting nuts.

4. Remove jack stands, lower car, and tighten wheel mounting nuts to 105 foot-pounds. (*See CAUTION on Page 4-3.)*

5. Install wheel disc and wheel shield.

37. Axle Shaft, Bearing Oil Seal, and Wheel Bearing

a. Removal of Axle Shaft and Bearing Assembly

1. Raise rear end of car and remove wheel and brake drum as described in Note 36a.

2. Remove four nuts that secure retainer and backing plate to rear axle housing.

3. Attach Slide Hammer, J-2619, to Axle Shaft Puller, J-21579, using Adapter, J-2619-4.

4. Install Axle Shaft Puller, J-21579, on studs of rear axle shaft flange, Fig. 4-41.

5. Drive outward with slide hammer and remove axle shaft.

(NOTE: The tapered roller unit type rear wheel bearing, when new, is bonded together to facilitate installation. If tapered roller unit bearing is used, the bearing may separate when removing the axle shaft, leaving the outer race in the axle housing. This is a normal condition and does not indicate failure. If the bearing is to be replaced, make sure the old bearing outer race is removed from the housing before installing a new bearing.)

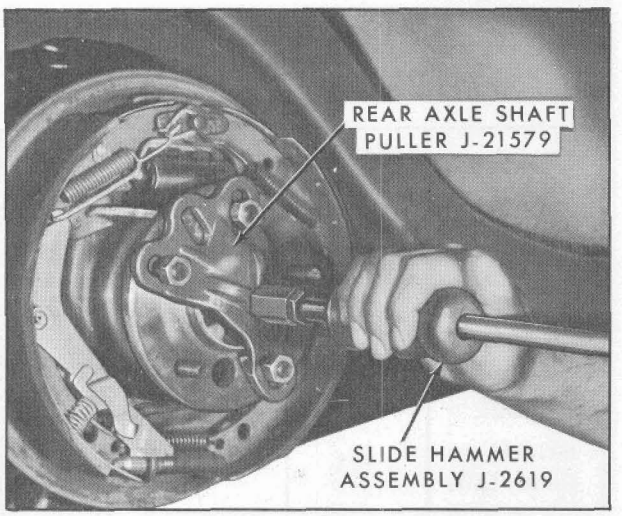


Fig. 4-41 Removing Rear Axle Shaft

b. Removing Rear Wheel Bearing and Oil Seal

1. Using a cold chisel and hammer, split bearing retainer next to bearing, being careful not to damage bearing or shaft.

(NOTE: Bearing retainer must be completely split. Drive chisel into retainer until retainer separates, then remove and discard retainer.)

2. Stand axle shaft upright on flanged end. Using two screwdrivers, pry oil seal away from wheel bearing.

3. Slide Press Plate, J-23399-1, over axle shaft and into position between bearing and bearing retainer, Fig. 4-42.

4. Install both halves of Bearing Puller, J-23399-2 (J-23399-3 for 697 and 698 Series) into Press Plate, J-23399-1, Fig. 4-42.

5. Position axle shaft and Press Plate in press and press bearing off axle shaft.

CAUTION: Make certain that axle shaft is properly centered in press so that axle shaft flange does not catch on side of press and become damaged.

6. Remove axle shaft from press.

7. Slide bearing, seal, and bearing puller tools up and off axle shaft.

8. Slide cover up and off axle shaft.

c. Installing Rear Wheel Bearing and Oil Seal

1. Wipe axle shaft and bearing clean.

2. Install bearing cover on axle shaft with raised side of cover against axle shaft flange, Fig. 4-43.

3. Install Seal Protector, J-23389, on axle shaft with small end of protector pointing toward splined end of axle shaft, Fig. 4-43.

4. Lubricate lip of new oil seal with wheel bearing grease.

5. Install oil seal by gently pressing seal down over

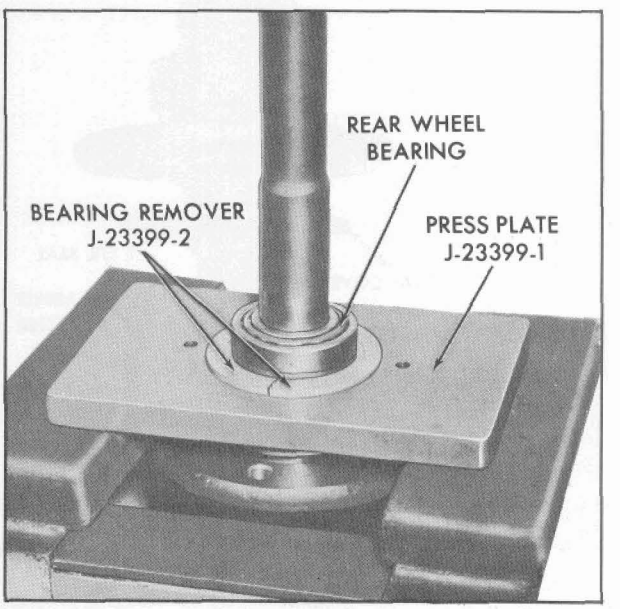


Fig. 4-42 Removing Rear Wheel Bearing

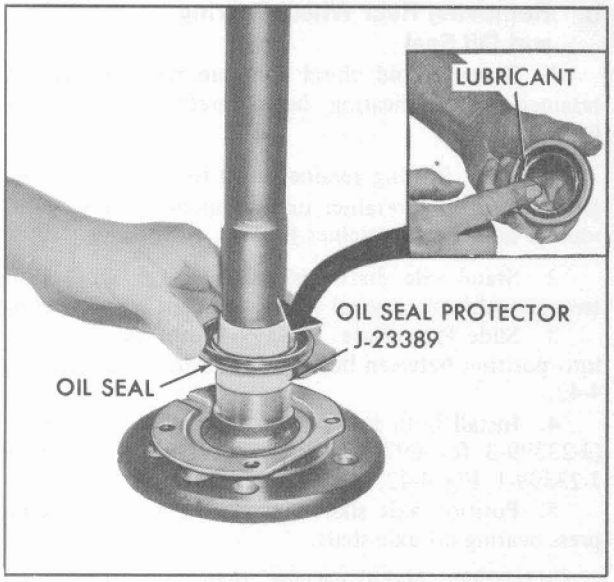


Fig. 4-43 Installing Rear Wheel Oil Seal

Seal Protector, J-23389. The oil seal is properly installed when the lip of the seal clears the large end of the seal protector.

(NOTE: When installing oil seal on 697 and 698 series vehicles, use Seal Protector, J-23391.)

6. Apply a light coat of wheel bearing grease on bearing.

7. If tapered roller unit bearing is used, position bearing on axle shaft with narrow ring of bearing facing flanged end of axle shaft. If straight roller bearing is to be installed, loose ring at one end of inner race must be installed toward the flange.

8. Position Bearing Installer, J-6257, on shaft and place axle shaft on press, making certain that axle shaft is properly centered in bearing installer, Fig. 4-44.

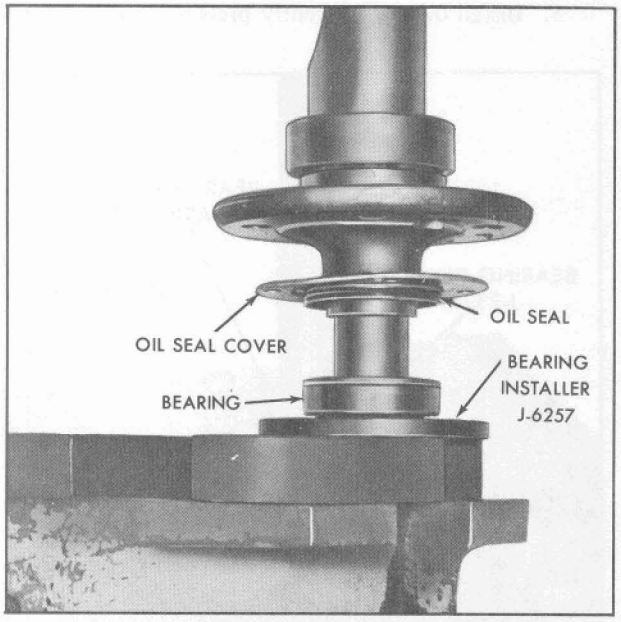


Fig. 4-44 Installing Rear Wheel Bearing

9. Press bearing on axle shaft until bearing bottoms against shoulder on shaft.

10. Remove Bearing Installer, J-6257, and position retainer on axle shaft.

11. Position Bearing Installer, J-6257, on shaft and place axle shaft on press, making certain that axle shaft is properly centered in bearing installer.

12. Press retainer on axle shaft until retainer bottoms against bearing.

13. Remove Bearing Installer, J-6257, from axle shaft.

d. Installing Axle and Bearing Assembly

(NOTE: If rear wheel bearing has been removed because of failure, inspect axle housing and differential carrier for metal chips and clean thoroughly.)

1. Apply a thin film of wheel bearing grease to wheel bearing bore in axle housing after checking housing for nicks and burrs.

2. Lubricate oil seal and outer race of bearing with wheel bearing grease.

3. Install new gasket on brake backing plate.

4. Install axle shaft into axle housing, using extreme care to align oil seal cover with axle housing mounting bolts.

(NOTE: It may be necessary to rotate axle shaft to permit axle shaft splines to engage differential side gear splines.)

5. Install four nuts on axle housing flange bolts to hold gasket, brake backing plate, and oil seal cover in place. Tighten nuts to 50 foot-pounds by inserting a socket wrench through large holes in rear axle shaft flange.

6. Install brake drum and one push nut.

7. Install wheel and lower car. Tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 4-3.)*

8. Install wheel disc and wheel shield.

SPECIFICATIONS

Series	Bearing Diameter	Length	
		Lefthand	Righthand
681-2-3 Std. Diff.	1.564	28.505	34.025
681-2-3 Contr. Diff.	1.564	27.715	34.815
697-698 Std. Diff.	1.773	28.505	34.025
697-698 Contr. Diff.	1.773	27.715	34.815

TORQUE SPECIFICATIONS

Material No.	Application	Size	Foot Pounds
301-M	Brake Backing Plate to Axle Housing Nuts . .	7/16-14	50*
286-M	Wheel Mounting Nuts	1/2-20	105*
286-M	Shock Absorber Lower Mounting Nut	1/2-20	50

**CAUTION: These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

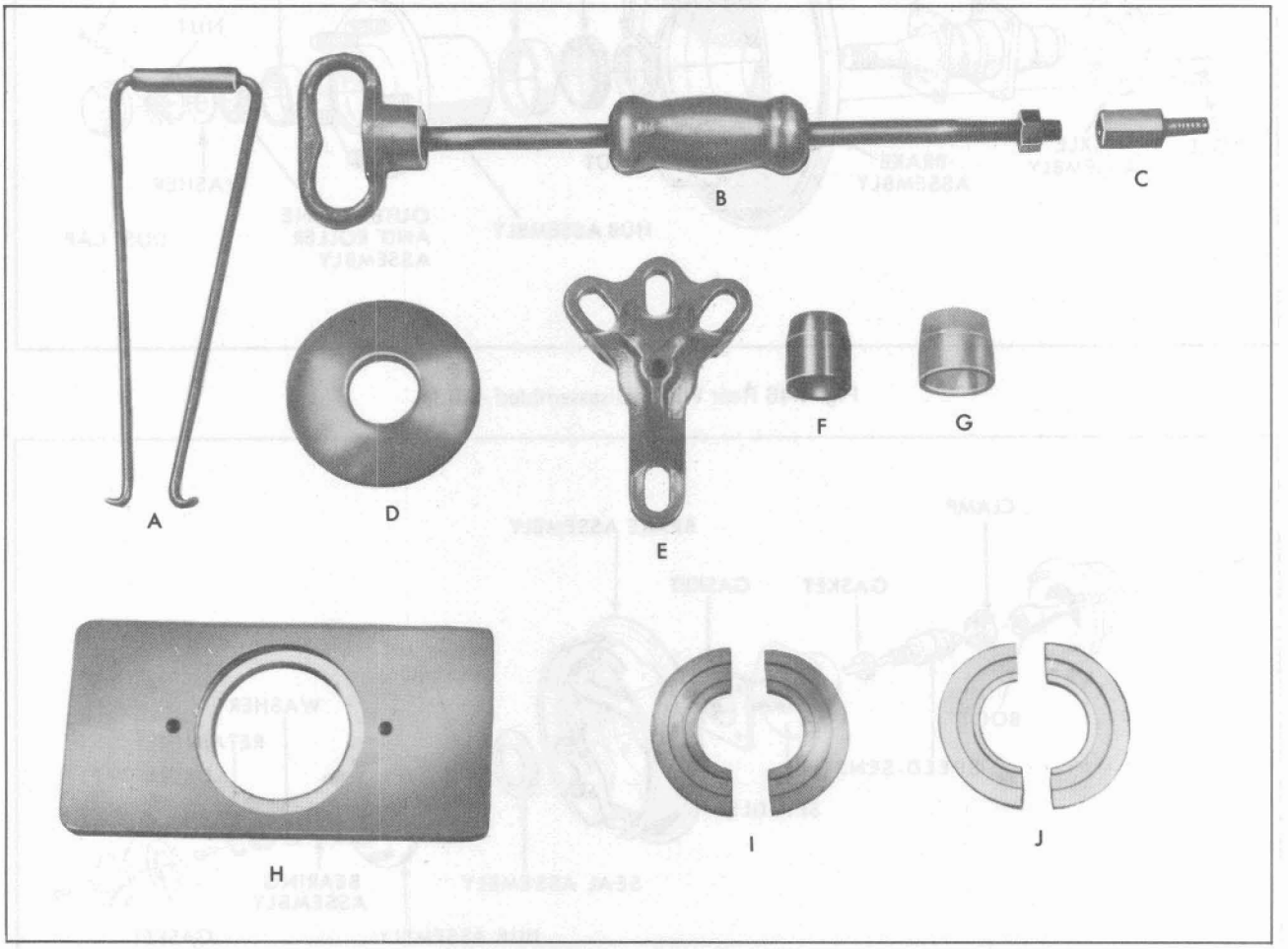


Fig. 4-45 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-943	Bearing Cup Remover	G	J-23391	Axle Shaft Seal Protector (Except Std. and Eldorado)
B	J-2619	Slide Hammer	H	J-23399-1	Axle Bearing Press Plate
C	J-2619-4	Adapter	I	J-23399-2	Bearing Remover (Standard Car)
D	J-6257	Rear Wheel Bearing Installer	J	J-23399-3	Bearing Remover(Except Standard Car)
E	J-21579	Rear Axle Shaft Puller			
F	J-23389	Axle Shaft Seal Protector (Standard Car)			

GENERAL DESCRIPTION

The rear axle used on 693 series cars is a straight, hollow tube, Fig. 4-46. The rear wheel spindles are pressed into and bolted to the axle tube assembly. On cars equipped with Track Master system, speed sensors are attached to each spindle and the wiring harness is routed through the inside of the axle, Fig. 4-47.

Tapered roller bearings are used in the rear hubs. For diagnosis information pertaining to this type of bearing, refer to Fig. 4-40 and the corresponding text.

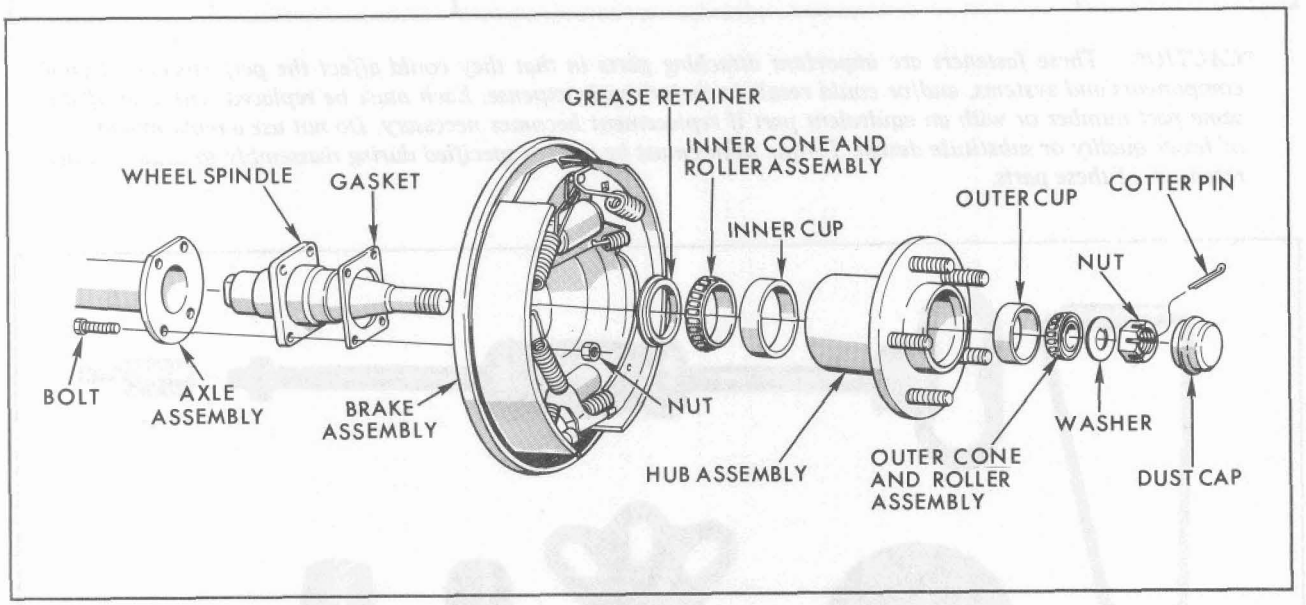


Fig. 4-46 Rear Wheel Disassembled - 693

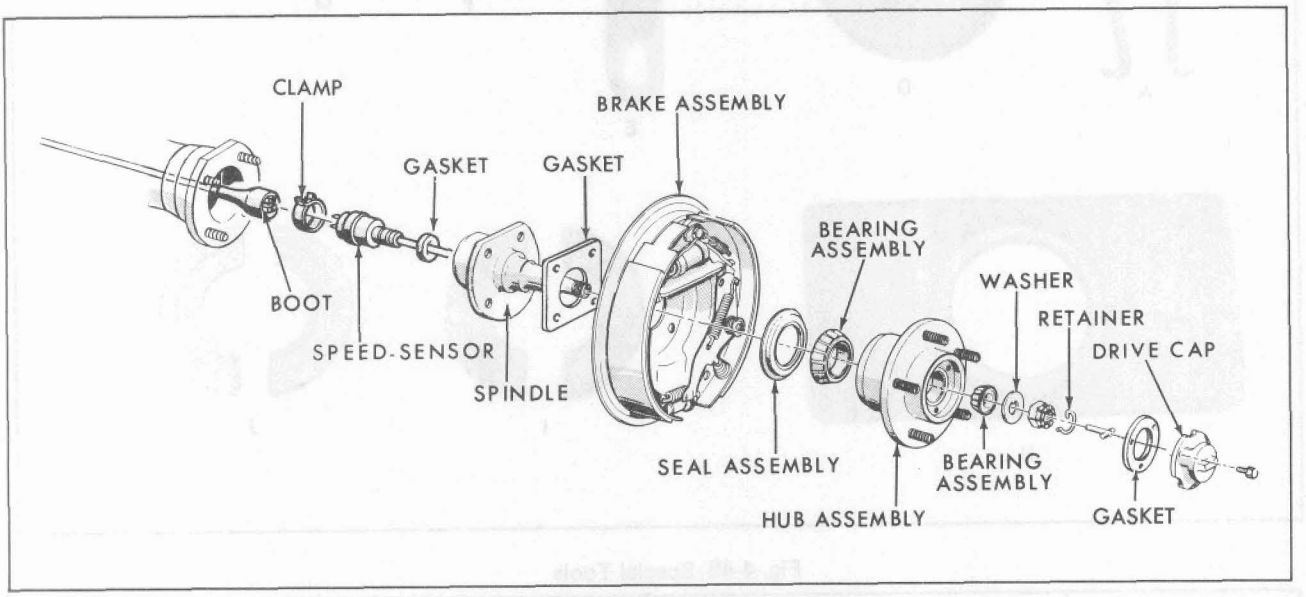


Fig. 4-47 Rear Wheel Disassembled - 693 With Track Master

SERVICE INFORMATION

The following service information pertains only to the Eldorado rear axle. For service procedures not given, refer to the forward portion of the appropriate subsection as the procedures are the same as on other 1972 Cadillacs.

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and

correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, and suspension control arms.

CAUTION: When raising rear of car, support vehicle weight at frame or axle or both. Never use control arms as contact points for hoist or jack stands.

38. Rear Wheel Bearing Adjustment

Regularly scheduled rear wheel bearing repacking is not required. When major brake service is being performed, however, it is recommended that the rear wheel bearings be cleaned and repacked with a high melting point grade 2 lithium grease.

Adjustment of the rear wheel bearings should be made while revolving the wheel at least three times the speed of nut rotation when taking the torque readings.

1. Check to make sure that hub is completely seated on wheel spindle.
2. While rotating wheel assembly, tighten spindle nut to 15 foot-pounds using a torque wrench. Make certain all parts are properly seated and that threads are free.
3. Back off spindle nut until free and retighten finger tight.
4. Install new cotter pin, or, if equipped with Track Master system, install retainer ring.

(NOTE: If cotter pin or retainer ring cannot be installed in either of the two available holes in the spindle with nut in the above position, loosen spindle nut until installation is possible.)

5. Peen end of cotter pin over sufficiently against side of nut. Cotter pin must be tight after installation. If it can be moved with finger, vibration may cause it to wear and break. If retainer ring is used, peening will not be necessary.
6. If car is equipped with Track Master system, insert pin into end of sensor assembly using pliers and install insulators on each end of pin. Pin should protrude equally from both sides of sensor shaft.

CAUTION: Care must be taken when installing pin to avoid damage to pin.

7. Install dust cap, or, if equipped with Track Master system, install drive cap using three screws, tightening to 20 inch-pounds.

39. Rear Hub

a. Removal

1. Raise rear of car and remove rear wheel.
2. Remove rear brake drum.
3. If equipped with Track Master system, proceed as follows:

a. Remove three screws securing drive cap to hub and remove drive cap, Fig. 4-47.

b. Remove retainer ring.

c. Remove spindle nut, washer, and outer cone and roller assembly.

d. Proceed to Step 5.

4. Remove dust cap, cotter pin, spindle nut, washer, and outer cone and roller assembly, Fig. 4-46.
5. Carefully pull hub off of spindle.

b. Installation

1. Install rear hub on spindle, after wiping any accumulated grease from spindle, leaving only a light film.
2. Install outer cone and roller assembly and washer over spindle into hub, and install spindle nut finger-tight.
3. Install rear brake drum.
4. Check and, if necessary, adjust rear service brakes.
5. Adjust rear wheel bearing as described in Note 38.
6. Install dust cap, or, if equipped with Track Master system, install drive cap using three screws, tightening to 20 inch-pounds.
7. Position wheel assembly on hub, installing wheel mounting nuts finger tight.
8. Lower car.
9. Tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 4-3.)*

40. Rear Wheel Bearings and Grease Retainer (Fig. 4-46)

a. Removal

1. Remove hub assembly as described in Note 39a.
2. Pry grease retainer from inner side of hub.

(NOTE: The inner bearing grease retainer tool, Section 3, Fig. 3-33, may be used to remove the grease retainer.)

3. Remove inner cone and roller assembly from hub.
4. Inner and outer bearing cups are press fitted in hub, and can be removed, if necessary, by driving out from opposite side with a brass drift.

b. Inspection

1. Thoroughly clean all parts in clean solvent.
2. Check bearings for cracked separators and worn or pitted rollers.
3. Check bearing races for defects, using Fig. 4-40 as a guide.

c. Installation

1. If inner bearing cup was removed, drive or press cup, small I.D. side first, into inner side of hub, using Universal Handle, J-8092, and Inner Bearing Cup Installer, J-8458.
2. If outer bearing cup was removed, drive or press cup, small I.D. side first, into outer side of hub, using Universal Handle, J-8092, and Outer Bearing Cup Installer, J-8849.
3. Pack bearing cage with high melting point grade 2 lithium grease. Use a commercial bearing packer or pack bearings by hand, forcing grease in at large end of cage until it protrudes from the small end.
4. Install inner cone and roller assembly into inner side of hub.

5. Drive or press new grease retainer into inner side of hub, using Universal Handle, J-8092, screwed into a flat sided tool, such as J-23114.

(NOTE: If J-23114 is used, screw Universal Handle into reverse side of tool.)

6. Wipe spindle clean and apply a thin film of wheel bearing grease to spindle.

7. Install rear hub as described in Note 39b.

41. Rear Wheel Spindle (On Car)

a. Removal

1. Raise rear of car.
2. Remove rear hub as described in Note 39a.
3. Disconnect brake line fitting at wheel cylinder.
4. Remove four nuts securing brake backing plate to spindle.
5. Remove brake backing plate from wheel spindle and place backing plate out of the way.
6. Start one brake backing plate to spindle nut just far enough to engage threads.
7. Attach Adapter, J-2619-4, to Slide Hammer, J-2619, and attach Spindle Adapter J-23692 to Adapter J-2619-4, and install assembly on spindle, Fig. 4-48.

(NOTE: Make sure all threads are fully seated.)

8. Use slide hammer assembly to drive spindle from axle.
9. Remove remaining spindle to backing plate bolt and nut and remove spindle.
10. If car is equipped with Track Master system, disconnect sensor wiring.
11. Remove slide hammer assembly from spindle.
12. If equipped with Track Master system:
a. Disconnect sensor clamp, boot, and wires.
b. Remove insulators and pin from end of sensor.
c. Unscrew and remove sensor from spindle, using a 1-5/8" open end wrench.

b. Installation

(NOTE: If spindle threads were damaged on removal, use a 3/4"-20 thread chaser to correct damage.)

1. If car is equipped with Track Master system, install new sensor gasket and screw sensor into spindle, tightening to 20 foot-pounds. Connect sensor wires, boot, and clamp.
2. Attach slide hammer assembly to new spindle, making sure threads are fully seated.
3. Drive new spindle into axle until spindle is fully installed, Fig. 4-48.
4. Install new gasket on wheel spindle.
5. Install brake backing plate on spindle and secure with four attaching nuts, tightening nuts to 40 foot-pounds.
6. Connect brake line fitting to wheel cylinder, tightening fitting to 14 foot-pounds.
7. Install rear hub as described in Note 39b.
8. Bleed brakes.

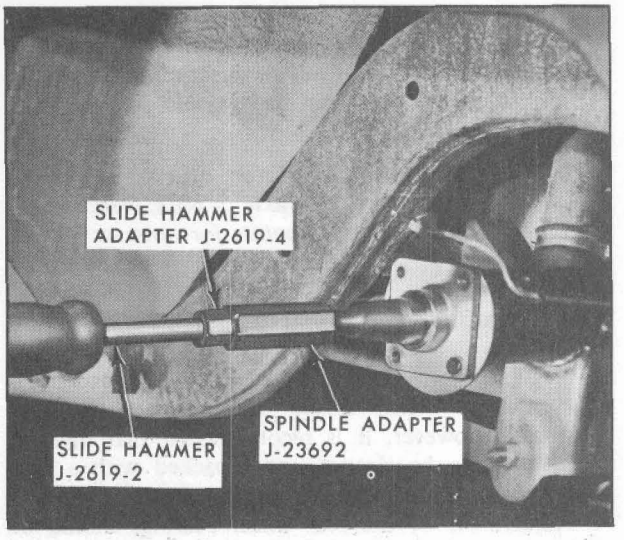


Fig. 4-48 Removing and Installing Rear Wheel Spindle

42. Rear Axle

a. Removal

1. Remove wheel shields, wheel discs, and loosen wheel mounting nuts.
2. Raise car on hoist and place jack stands under frame side rails.
3. Lower axle until axle is free of hoist, then raise hoist just enough to support weight of axle (about 3/8").
4. Remove wheel mounting nuts and both wheel and tire assemblies.
5. Remove rear hub assemblies as described in Note 39a, Steps 2 through 5.
6. Disconnect brake lines at wheel cylinders.
7. Disconnect rubber brake hose and cap the hose to minimize fluid leakage.
8. Disconnect overtravel link from bracket on rear axle.
9. Deflate shock absorbers by disconnecting white air line at height control valve.
10. Remove four nuts that hold brake backing plates to spindles and move backing plates out of way.
11. Remove wheel spindles, following procedure of Note 41a, Steps 6 through 12a.
12. Remove brake pipes from four clips securing pipes to axle housing.
13. If car is equipped with Track Master system, remove screw and clip securing sensor cable to axle, and remove cable grommet and connectors through 5/8" hole in axle. Separate cable at grommet.
14. Disconnect shock absorbers at lower mounts and position out of way.
15. Raise axle to relieve tension on upper control arms and remove bolt and nut securing each upper control arm to axle brackets.

WARNING: STAND CLEAR OF AXLE ASSEMBLY WHEN PERFORMING NEXT STEP. SPRINGS COULD SNAP FROM THEIR SEATS.

16. Carefully lower axle until spring tension is relieved, then remove springs by hand.

17. Remove bolt and nut securing each lower control arm to its axle bracket.

(NOTE: Axle may have to be rotated slightly to facilitate bolt removal.)

18. Remove bolt securing brake line junction fitting to axle.

19. Remove rubber bumpers from top of axle housing.

20. Lower axle from car.

b. Installation

1. Install rubber bumpers on top of new axle.
2. Secure brake pipes on axle assembly using four clips.
3. Position new axle under car.
4. If car is equipped with Track Master system, proceed as follows:

a. Insert wires through either end of axle so that sensor connectors hang from both ends of axle and cable connectors align with 5/8" hole in axle.

b. Connect wires leading from frame.

c. Install grommet and secure with clip and screw.

5. Install plug securing brake line junction fitting to axle.
6. Raise axle only as far as necessary to insert lower control arms in axle brackets. Install lower arms and bolts and nuts but do not torque at this time.

(NOTE: It may be necessary to rotate axle slightly to align bolt holes. If so, use a jack stand at front or rear of one of the lower control arm brackets while adjusting axle height with hoist.)

7. Pivot upper control arms upward and secure arms temporarily in this position.
8. Fully extend shock absorbers; then raise axle until shock absorbers lower mounts are aligned. However, do not install shock absorbers at this time.
9. Install spring insulators and install springs, indexing as shown in Fig. 4-9. Raise axle just enough to compress springs slightly.
10. Drop upper control arms into axle brackets and install bolts and nuts. Do not torque at this time.
11. Position shock absorbers in lower mounts and install nuts.
12. Connect white air line to superlift port of height control valve.
13. Raise overtravel lever briefly to allow air into shock absorbers.
14. Connect overtravel lever to axle bracket. Shock abosrbers will exhaust to residual pressure of 8-15 psi.
15. Raise axle until weight of car is supported by front and rear suspensions. Remove jack stands.
16. Torque lower control arm bolts to 100 foot-pounds, upper control arm bolts at frame to 100 foot-pounds, upper control arm bolts at axle to 75 foot-pounds, and shock absorber lower mounting nuts to 50 foot-pounds. *(See CAUTION on Page 4-3.)*
17. Connect rubber brake hose to brake pipes.
18. Install wheel spindles as described in Note 41b, Steps 1 through 6.
19. Install rear wheel hubs as described in Note 39b, Steps 1 through 9.
20. Using service valve, inflate Automatic Level Control system to 140 psi, or maximum pressure available.
21. Bleed brakes.

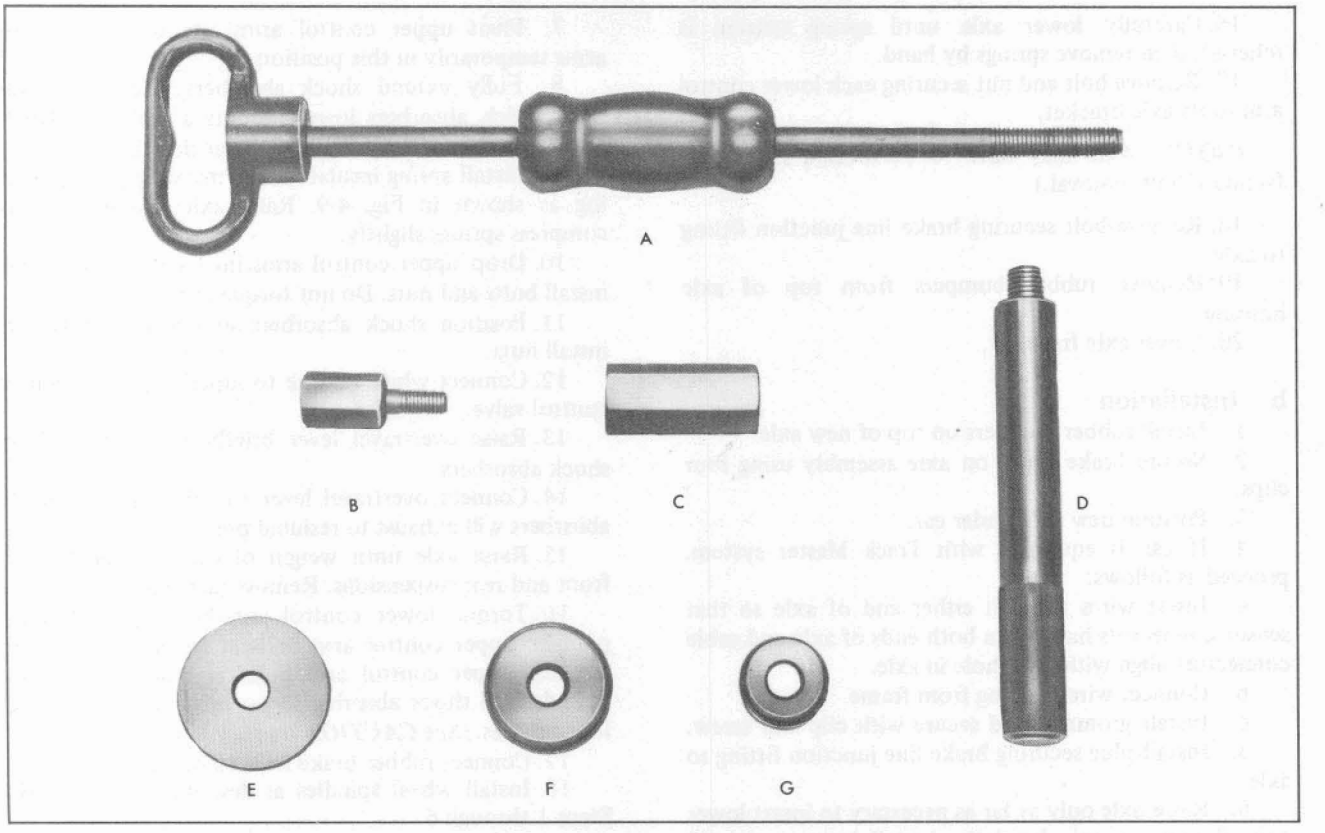


Fig. 4-49 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-2619	Slide Hammer	E	J-23114	Grease Retainer Installer
B	J-2619-4	Slide Hammer Adapter	F	J-8458	Inner Bearing Cup Installer
C	J-23692	Spindle Adapter	G	J-8849	Outer Bearing Cup Installer
D	J-8092	Universal Handle			

GENERAL INFORMATION

(NOTE: The following information is not applicable to the Eldorado.)

The standard differential, incorporating a unitized carrier and housing design, Fig. 4-50, is used on all 1972 Cadillac cars except the Eldorado, and is completely serviceable. The Controlled Differential gear case, using the same carrier and housing design, Fig. 4-86, is available on all 1972 Cadillac cars except the Eldorado, and is serviceable only as a unit.

This axle design utilizes two tapered roller bearings and a straight roller straddle bearing to support the pinion and provide rigidity. Adjustment of the pinion depth is accomplished through the use of shims at the pinion retainer to differential carrier connection.

The ring gear is secured to the differential gear case with 12 left hand thread screws. In the event the ring gear or the pinion should become damaged, both must be replaced because they are lapped as a matched set.

Pinion-ring gear backlash adjustment is accomplished through the use of a shim located to the left of the left side bearing. The differential bearing preload is adjusted by means of an adjuster nut that is retained under the right side bearing cap which, in addition to the shim, provides the correct backlash of .005 to .010 inch.

The differential carrier has a pinion mounted flange for attachment of the propeller shaft.

A bolt-on differential carrier nose bumper arm that extends over the rear universal joint, is used on all series cars except the 698 series. The arm limits the axle wind-up by contacting a bumper on the underbody.

Controlled Differential

The Controlled Differential gear case is serviced only as a complete assembly.

The pinion depth, differential backlash and side bearing preload adjustments are made using the same procedures that are used in adjusting the standard differential.

The basic advantage of the optional Controlled Differential over the standard differential is that the major driving force is always directed to the wheel having the greater traction. The unit is not a positive lock type. It will slip before an excessive amount of torque is directed to one rear wheel.

The main purpose of the Controlled Differential is to reduce the possibility of the car getting stuck while driving under slippery conditions. It also minimizes wheel spin and resultant drive line shock when accelerating on an uneven road surface.

During normal driving and cornering, the Controlled Differential unit functions as a standard differential. When one wheel encounters a slippery surface, however, the Controlled Differential allows the wheel with the greater traction to drive the car.

Wheelspin can occur if over-acceleration is attempted. However, the major driving force will still be directed to the wheel having the greater traction. This condition does not indicate failure of the unit.

When checking the runout of rear wheels on cars equipped with Controlled Differential, be sure to raise both rear wheels off the ground. Otherwise, the wheel in contact with the ground will drive when the opposite wheel is raised and rotated.

Use only the special lubricant available from servicing parts warehouses on cars equipped with the Controlled Differential to assure satisfactory operation of the unit. Use of other types of lubricants, including some that are specified by their manufacturer as "for use in all limited slip differentials", may cause a chatter or other noise . . . even when added to the factory-installed lubricant in small amounts.

All service information in this section applies to the controlled as well as the standard differential carrier assemblies, unless otherwise noted.

Differential Carrier Gear Ratios

The differential carrier gear ratios used on the different series cars provide maximum performance and economy for each series.

The gear ratio of the rear axle assembly used on 1972 Cadillac cars can be determined by an identification number placed on the differential, as shown in Fig. 4-51.

In the case of a Controlled Differential, the letter "G" precedes the differential carrier identfication number. For example: "G-3" is a Controlled Differential with a gear ratio of 2.93-1.

The gear ratios and corresponding identification numbers for the various series are as follows:

Ratio	Identification Number*
2.93–1	3
3.15–1	5
*Letter "G" preceding the identification number indicates a Controlled Differential	

43. Differential Overhaul

a. Preparatory Steps

1. Position car on hoist.
2. Remove both rear wheel shields and wheel discs.
3. Loosen wheel mounting nuts on both rear wheels.
4. Raise car on hoist and place jack stands under rear frame cross member. Lower axle to improve access.

CAUTION: Never use control arms as contact points for hoist or jack stands.

5. Remove rear wheel mounting nuts and both rear wheels.
6. Remove push nut securing brake drum to axle shaft bolt.

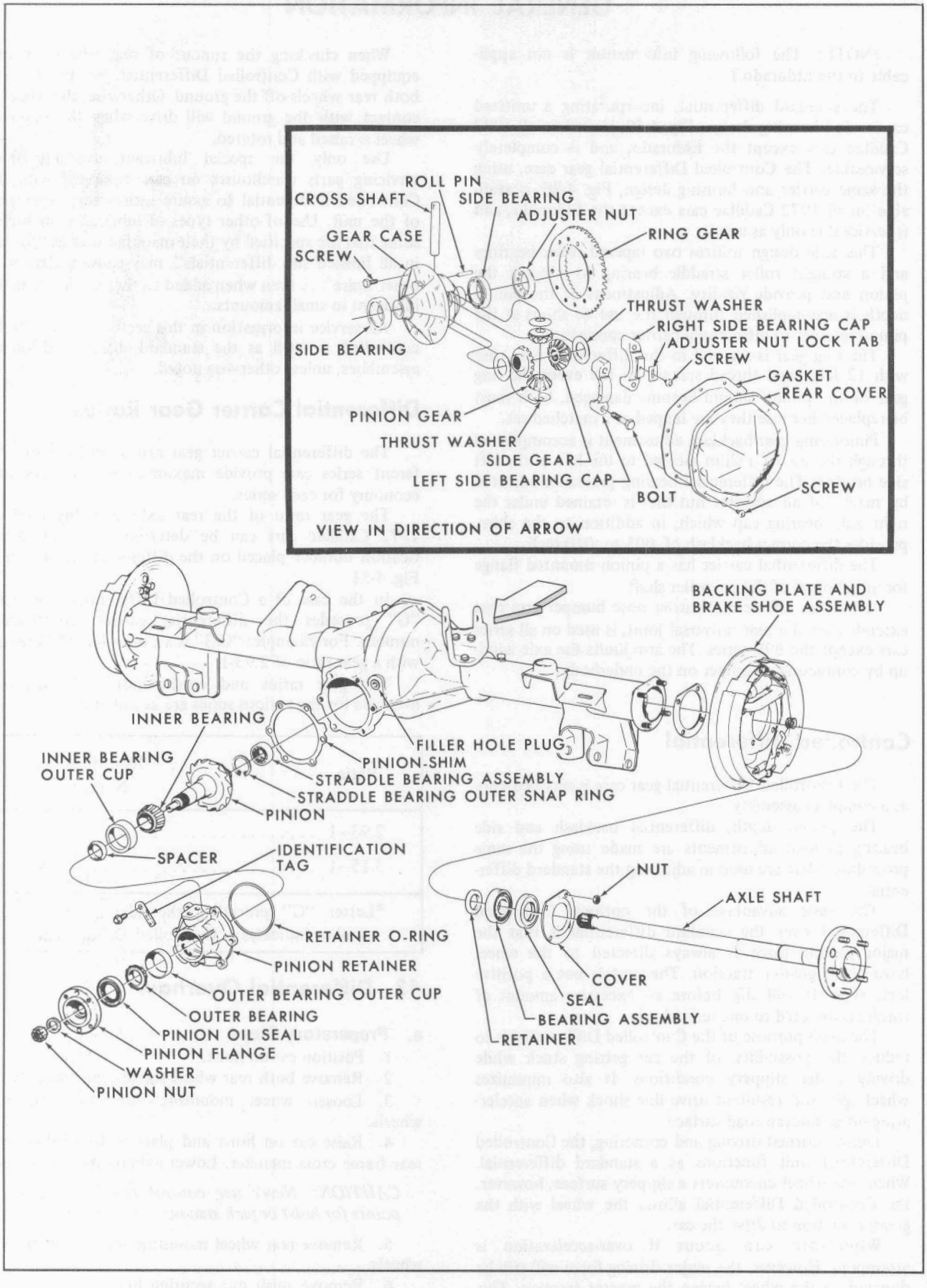


Fig. 4-50 Differential Carrier and Rear Axle

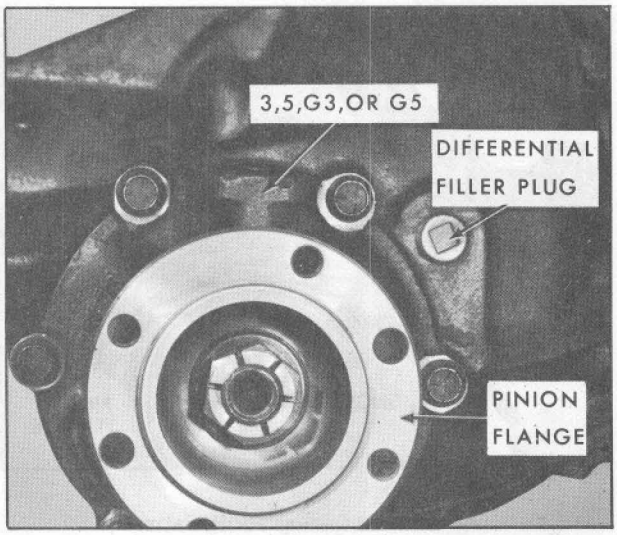


Fig. 4-51 Gear Ratio Identification

7. Remove brake drum.

8. Remove four nuts that secure retainer and backing plate to rear axle housing.

9. Attach Slide Hammer, J-2619, and Adapter, J-2619-4, to Axle Shaft Puller, J-21579.

10. Install Axle Shaft Puller, J-21579, on studs of rear axle shaft flange, Fig. 4-41.

11. Drive outward with slide hammer and remove axle shaft.

(NOTE: The tapered roller unit type rear wheel bearing, when new, is bonded together to facilitate installation. If tapered roller unit bearing is used, the bearing may separate on axle shaft removal leaving the outer race in the axle housing. This is a normal condition and does not indicate failure. If the bearing is to be replaced, make sure the old bearing outer race is removed from the housing before installing a new bearing.)

12. Install two nuts on brake backing plate mounting studs to prevent backing plates from falling and damaging brake lines.

CAUTION: Brake lines must not be used to support the backing plate and brake shoe assembly.

13. Remove two attaching screws and lockwashers that secure differential carrier nose bumper arm and remove nose bumper arm.

14. (Presence of hose clamps on rear of propeller shaft indicate that a field rebalancing procedure has been performed. To preserve balance, scribe an alignment mark between propeller shaft rear flange and pinion flange for proper orientation on re-installation.)

Install wire or chain to support propeller shaft as shown in Fig. 4-25, then disconnect propeller shaft in the following manner.

a. Of the four universal joint flange attaching screws and lockwashers, remove the two that are most accessible.

b. Rotate propeller shaft to gain access to remaining two flange attaching screws and lockwashers.

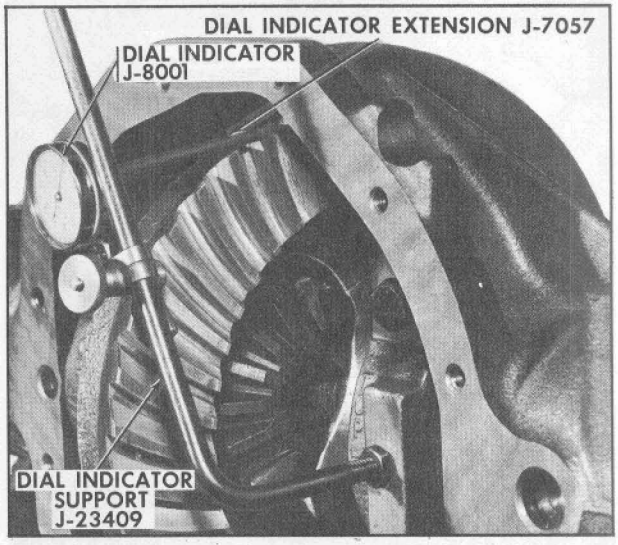


Fig. 4-52 Checking Pinion to Ring Gear Backlash

c. Remove screws and lockwashers and allow shaft to rest on wire or chain.

15. Place a drain pan under differential.

16. Loosen 12 differential cover to carrier screws. Slide cover back on screws and allow lubricant to drain from differential.

17. Remove 12 differential cover to carrier screws and remove differential cover and gasket.

CAUTION: Take care not to damage brake lines and hoses now and throughout procedure.

b. Total Preload

1. Attach a 50 inch-pound torque wrench to the pinion nut using a 1-1/4" socket.

2. Rotate pinion approximately two turns in each direction and record maximum reading obtained. Disregard torque required to begin turning pinion.

c. Backlash Check

1. Remove adjuster nut lock tab.

2. Using Dial Indicator, J-8001, and Dial Indicator Support, J-23409, determine and record ring gear to pinion backlash, Fig. 4-52. If original pinion and ring gear set is to be used on reassembly, and mileage is greater than approximately 3000, it may be important to re-establish this exact backlash measurement on reassembly.

(NOTE: Indicator button should touch the ring gear tooth on face of drive side at heel. Angle between indicator button and tooth face must be 90°. Backlash is measured by rocking ring gear back and forth with pinion securely held. Take three readings evenly spaced around the ring gear. The readings should all fall between .005" and .010" and should not vary from each other by more than .003".)

3. Remove dial indiactor and support from unit.

d. Tooth Pattern Check

1. Remove all but one of six pinion retainer to differential carrier screws. Loosen the remaining screw but do not remove at this time.

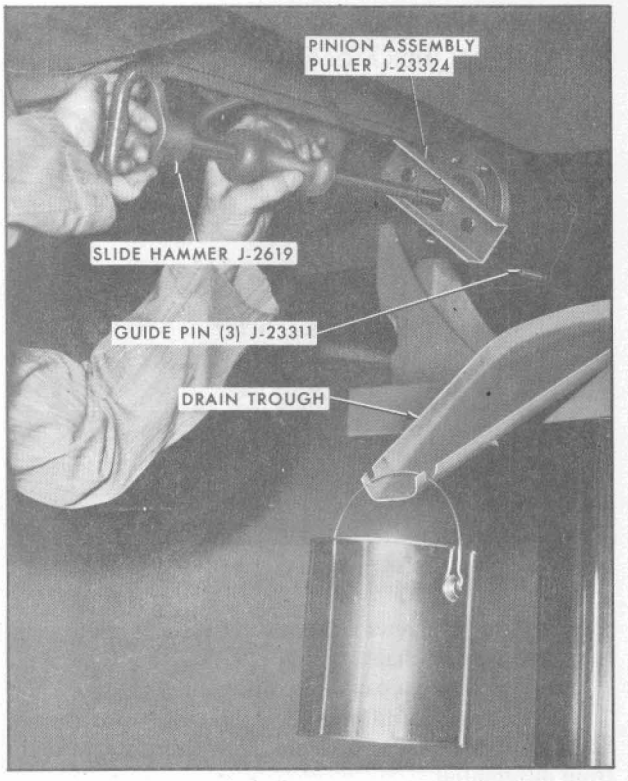


Fig. 4-53 Removing Pinion Assembly

2. Install Guide Pins, J-23311.

3. Attach Slide Hammer, J-2619, to Pinion Puller, J-23324.

4. Attach Pinion Puller, J-23324, to pinion flange, Fig. 4-53.

5. Using slide hammer, unseat pinion assembly from differential carrier, Fig. 4-53. Leave shim(s) in installed position.

6. Remove remaining screw, and slide pinion over guide pins and out of differential carrier.

7. Remove puller tools from pinion flange.

8. Clean ring gear teeth throughly, and paint teeth with special yellow gear marking compound, Part No. 1051196.

9. Clean pinion gear teeth thoroughly and re-install assembly in housing using three of six screws, tightening to 30 foot-pounds.

10. Turn ring gear manually one complete turn in each direction, using a box end wrench on the ring gear to case screws. During this operation, hold a rag around the pinion and grip firmly so that additional effort is required to turn ring gear, Fig. 4-54. This load assures clarity and accuracy of tooth pattern.

11. Compare pattern to samples in Tooth Pattern Chart, Fig. 4-55, to determine whether shim change is required.

e. Bench Check of Pinion Flange Runout

1. Remove pinion assembly from housing by following procedure in Note 43d, Steps 1 through 7.

2. Remove pinion shim from carrier and remove and discard pinion retainer O-ring.

3. Install pinion retainer in Holding Fixture, J-23320, Fig. 4-56.

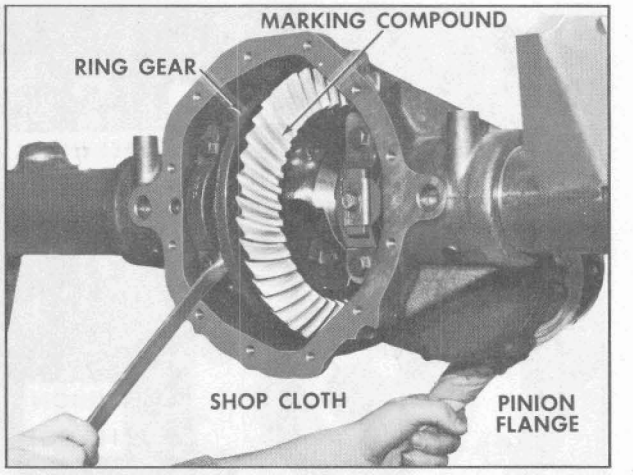


Fig. 4-54 Obtaining Tooth Pattern

4. Using a wire brush, clean pinion flange face thoroughly.

(NOTE: Heavy scale may have to be cleaned with carbon scraper. Never use a file on any area of the flange. If rust cannot be removed from pinion flange face, replace flange. Inspect flange face for damage or burrs. If either of these conditions exist, flange must be replaced. Nicks on O.D. of flange of 1/4" or less are acceptable. Clean propeller shaft rear flange also, to facilitate re-installation.)

5. Remove one pinion retainer screw from holding fixture and install Dial Indicator, J-8001, and Support, J-6126, so that indicator touches flange between bolt holes and pilot diameter at a 90° angle, Fig. 4-57. Set dial to zero.

6. Rotate pinion flange one complete revolution in each direction and record maximum face runout reading.

7. Attach Dial Indicator Extension, J-7057, and reposition dial indicator so that stem touches side of pinion flange pilot diameter, Fig. 4-58.

8. Repeat Step 6 to find radial runout. Combined face and radial runout should not exceed .005".

f. Pinion Disassembly

The differential ring gear and pinion are serviced as a matched set. In the event that one or the other becomes damaged, both the ring gear and pinion must be replaced.

1. Determine preload of pinion assembly using a 50 inch-pound torque wrench and a 1-1/4" socket. Turn pinion two revolutions in each direction and, disregarding torque required to begin turning pinion, record maximum reading.

2. WARNING: FAILURE TO EMPLOY RETAINING BAG J-23320-1, AS DIRECTED IN THE FOLLOWING STEP AND THROUGHOUT PROCEDURE WILL CAUSE DAMAGE TO PARTS AND MAY ALSO RESULT IN SERIOUS PERSONAL INJURY. EVEN WITH BAG INSTALLED, BE CERTAIN TO KEEP FEET AWAY FROM DIRECTLY UNDER PINION ASSEMBLY.

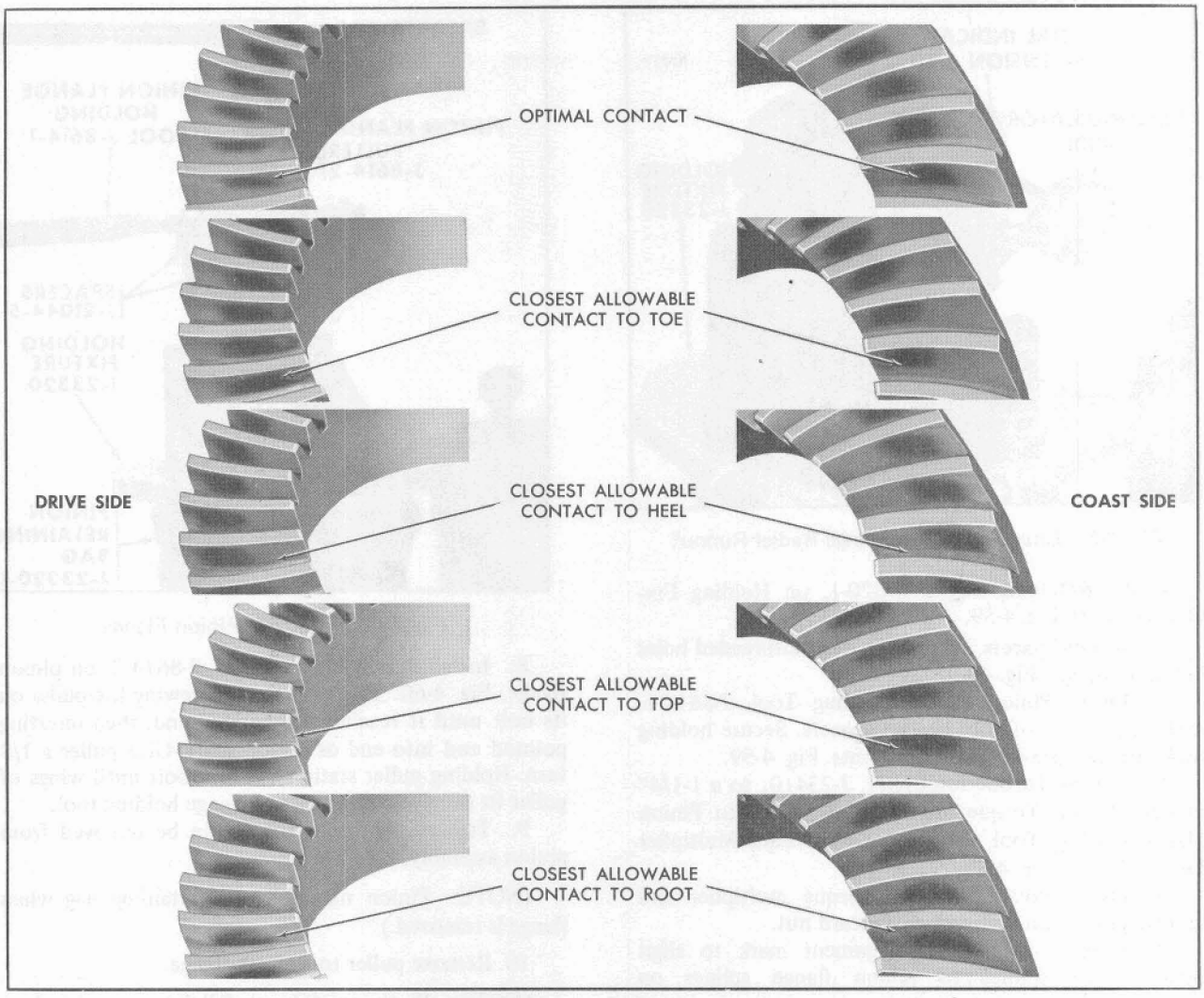


Fig. 4-55 Tooth Pattern Chart



Fig. 4-56 Pinion Assembly in Holding Fixture

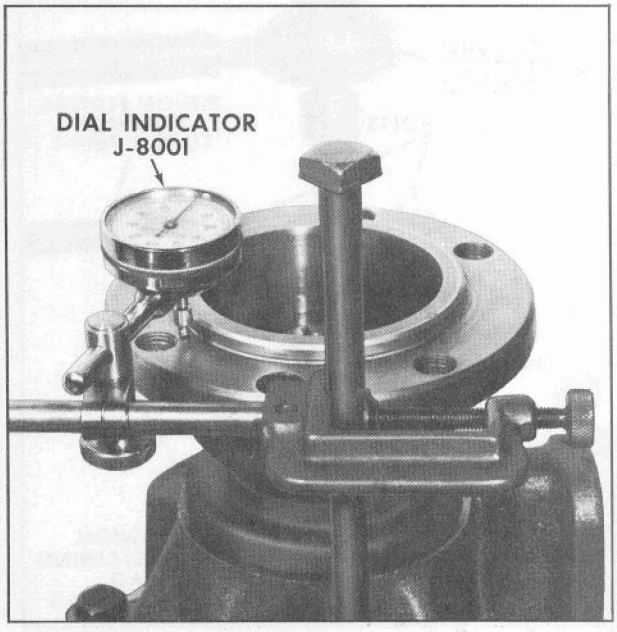


Fig. 4-57 Checking Pinion Flange Face Runout

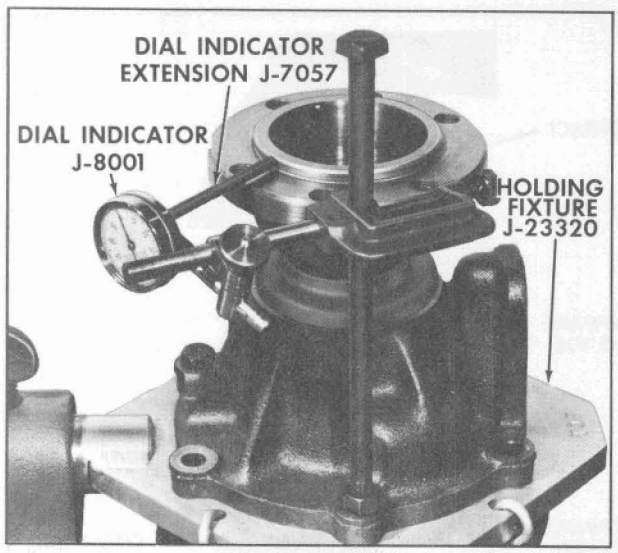


Fig. 4-58 Checking Pinion Flange Radial Runout

Install Retaining Bag, J-23320-1, on Holding Fixture, J-23320, Fig. 4-59.

3. Install Spacers, J-21044-5, over unthreaded holes in pinion flange, Fig. 4-59.

4. Install Pinion Flange Holding Tool, J-8614-1, with raised side of tool against spacers. Secure holding tool with two 3/8-inch bolts and nuts, Fig. 4-59.

5. Attach Torque Multiplier, J-23410, to a 1-1/4" socket. Attach Torque Multiplier, J-23410, to Pinion Flange Holding Tool, J-8614-1, with Torque Multiplier Link, J-23413, Fig. 4-59.

6. Install breaker bar on torque multiplier and remove pinion nut and washer. Discard nut.

7. Scribe or punch an alignment mark to align pinion shaft splines to pinion flange splines on reassembly.

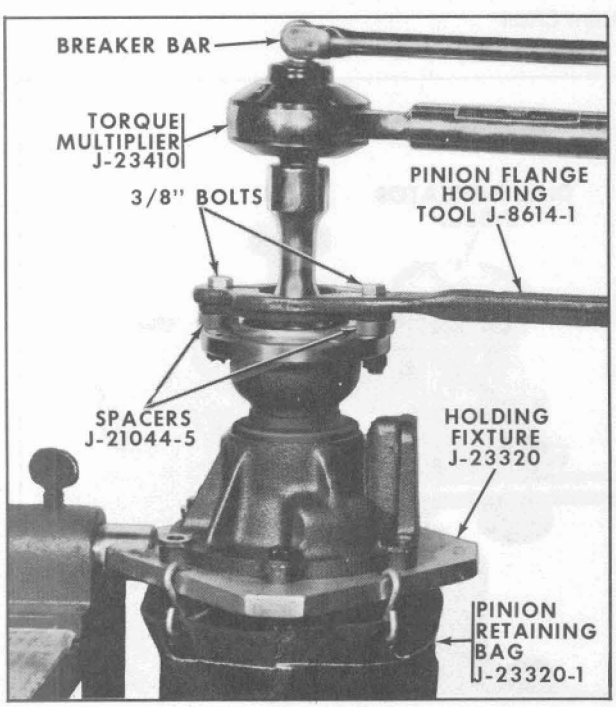


Fig. 4-59 Removing and Installing Pinion Nut

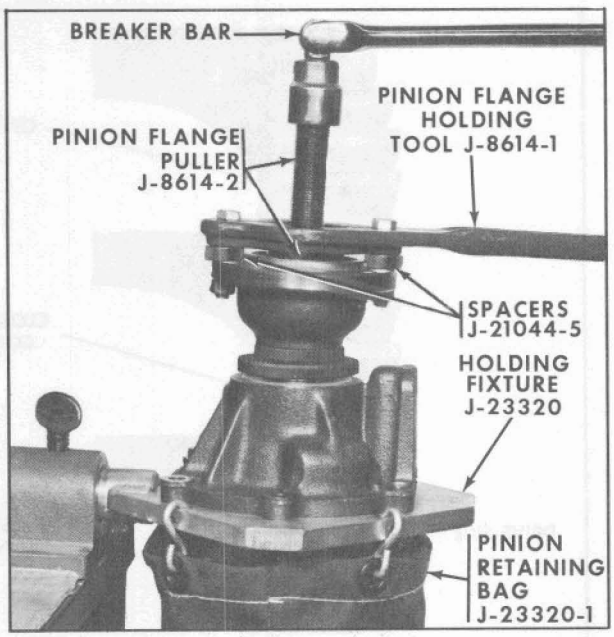


Fig. 4-60 Removing Pinion Flange

8. Install Pinion Flange Puller, J-8614-2, on pinion flange, Fig. 4-60. This is done by screwing the puller on its bolt until it reaches the pointed end, then inserting pointed end into end of pinion shaft. Give puller a 1/8 turn. Holding puller stationary, turn bolt until wings of puller fit snugly into recesses of flange holding tool.

9. Tighten bolt until flange can be removed from pinion assembly, Fig. 4-60.

(NOTE: Pinion may fall into retaining bag when flange is removed.)

10. Remove puller tools from flange.

(NOTE: If pinion did not fall into retaining bag, tap pinion shaft several times with a soft hammer. If this fails, place a block of wood on shaft and, supporting pinion from under retaining bag with one hand, use a heavy ball peen hammer to separate pinion from retainer.)

11. Remove retaining bag and pinion from holding fixture.

CAUTION: Be careful not to drop pinion.

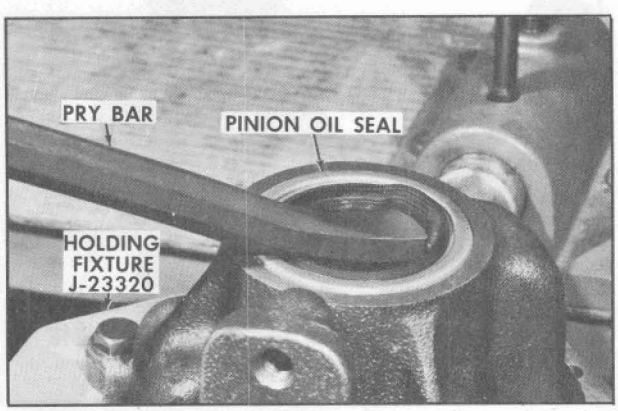


Fig. 4-61 Removing Pinion Oil Seal

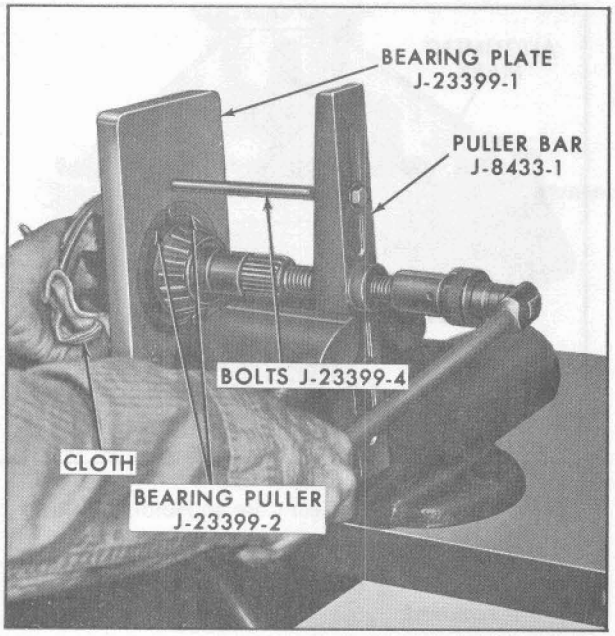


Fig. 4-62 Removing Pinion Inner Bearing

12. Pry pinion oil seal from retainer, using care so as not to damage inner surface of retainer, Fig. 4-61.

13. Remove outer bearing from retainer.

14. Remove collapse spacer from pinion shaft and discard spacer.

15. Install Bearing Plate, J-23399-1, on pinion and both halves of Bearing Puller, J-23399-2, Fig. 4-62.

16. Position Puller Bar, J-8433-1, on top of pinion shaft. Then, using two Bolts, J-23399-4, attach puller bar to bearing plate, Fig. 4-62.

17. Place assembly in vise, Fig. 4-62. With one hand on pinion gear teeth, tighten large center bolt on puller bar until pinion inner bearing is removed.

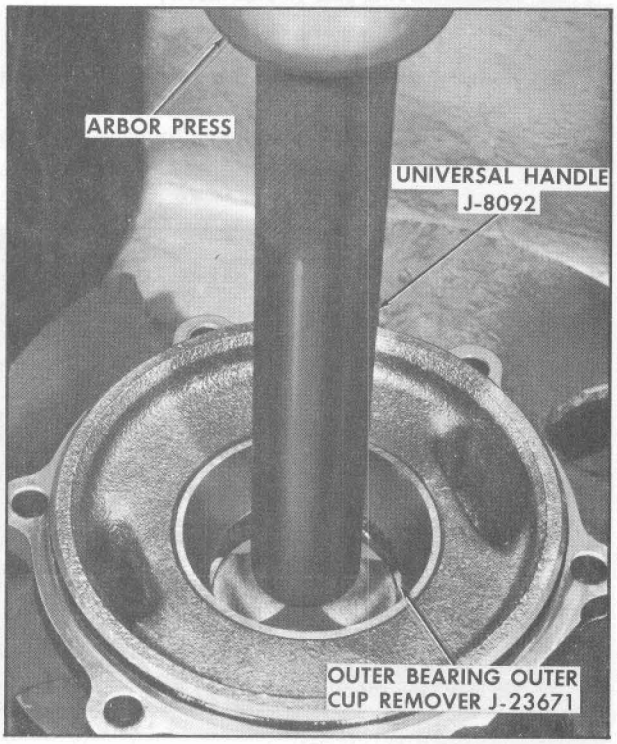


Fig. 4-63 Removing Outer Bearing Outer Cup

18. Attach Universal Handle, J-8092, to Pinion Outer Bearing Outer Cup Remover, J-23671.

19. Install Pinion Outer Bearing Outer Cup Remover, J-23671, in retainer Fig. 4-63.

(NOTE: When installing remover, it will be necessary to slide one end of tool into oil passage in retainer. Then slide tool into position to remove outer bearing cup.)

20. Place retainer in arbor press and carefully press outer bearing cup from retainer.

21. Remove Universal Handle, J-8092, from Pinion Outer Bearing Outer Cup Remover, J-23671, and install it in raised side of Pinion Inner Bearing Outer Cup Remover, J-23321.

22. Turn retainer over in press and install bearing cup remover in retainer, Fig. 4-64.

23. Carefully press inner bearing outer cup from retainer.

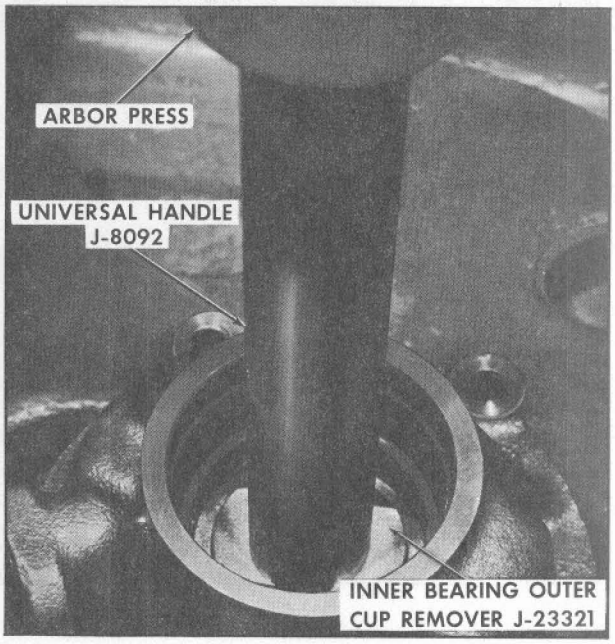


Fig. 4-64 Removing Inner Bearing Outer Cup

g. Cleaning and Inspection of Pinion Assembly Components

1. Clean all parts with cleaning solvent.

2. Inspect all parts for nicks, wear, or cracks. Nicks on O.D. of flange up to 1/4" deep are acceptable.

h. Checking Gear Case Spread and Removing Gear Case Assembly

1 Install Dial Indicator, J-8001, Dial Indicator Support, J-23409, and Plate, J-23409-1, as shown in Fig. 4-65. Indicator should make firm contact with plate and a 90° angle with plate. Set dial indicator to zero.

2. Loosen but do not remove mounting bolts securing left bearing cap to carrier.

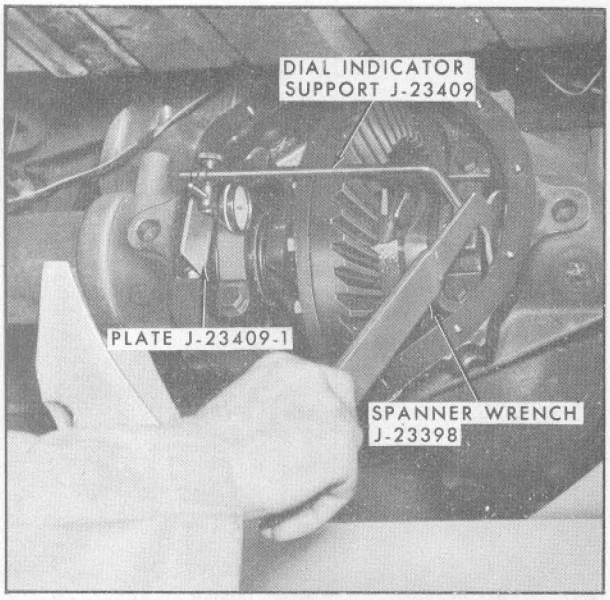


Fig. 4-65 Obtaining Gear Case Spread

(IMPORTANT: Use extreme care to avoid disturbing dial indicator, support, or plate when loosening mounting bolts.)

3. Loosen adjuster nut, using Spanner Wrench, J-23398, until tension on adjuster nut is released.

4. Record reading from dial indicator and remove indicator, support, and plate from carrier.

5. Remove both bearing caps.

6. Remove adjuster nut.

7. Slide gear case to right to remove differential shim.

8. Remove differential gear case from carrier housing, Fig. 4-66.

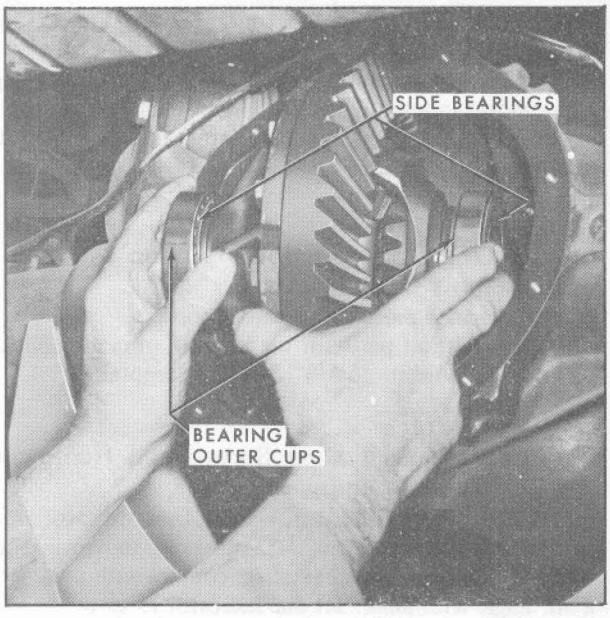


Fig. 4-66 Removing and Installing Gear Case

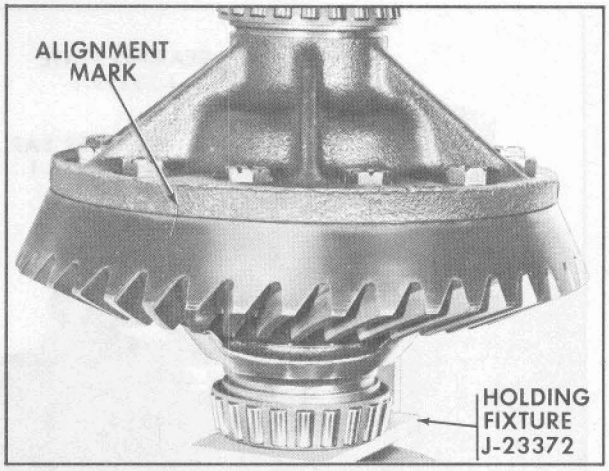


Fig. 4-67 Position of Gear Case on Holding Fixture

CAUTION: Use extreme care to prevent differential side bearing outer cups from dropping when gear is removed.

i. Gear Case Disassembly

NOTE: When working with Controlled Differential, skip Parts i, j, and o of Note 43, and perform the equivalent procedure of Note 45. The differential ring gear and pinion are serviced as a matched set. In the event one or the other becomes damaged, both the ring gear and pinion must be replaced.

1. Install Differential Case Holding Fixture J-23372, in vise, and position differential case on holding tool, Fig. 4-67.

2. Scribe an alignment mark on differential case and ring gear.

3. Loosen 12 ring gear to case screws.

(NOTE: These screws have left hand threads.)

4. Remove only three of the twelve screws and install Guide Pins, J-23316-1.

5. Remove gear case from holding tool and place on

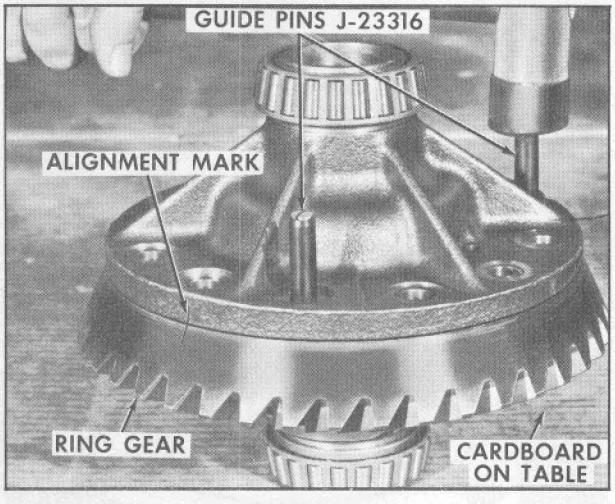


Fig. 4-68 Removing Ring Gear From Gear Case



Fig. 4-69 Removing Cross Shaft Roll Pin

table covered with cardboard, with ring gear facing downward.

6. Remove remaining nine screws.

7. Tap on guide pins to unseat and remove ring gear, Fig. 4-68.

8. Using a 1/4" diameter pin punch, remove differential cross shaft roll pin, Fig. 4-69.

9. Using a brass rod, remove differential cross shaft, Fig. 4-70.

10. Rotate pinion gear until gears align with opening in differential, Fig. 4-71.

11. Remove one differential pinion gear and thrust washer through opening in gear case.

CAUTION: When removing differential pinion gear, place one hand inside differential case and hold side gear to prevent it from falling in case.

12. Remove remaining differential pinion gear and thrust washer.

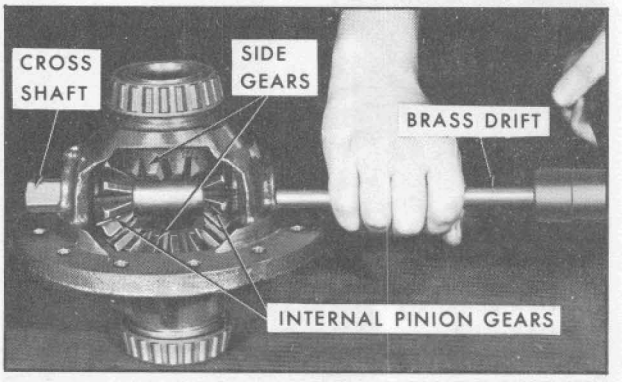


Fig. 4-70 Removing Cross Shaft

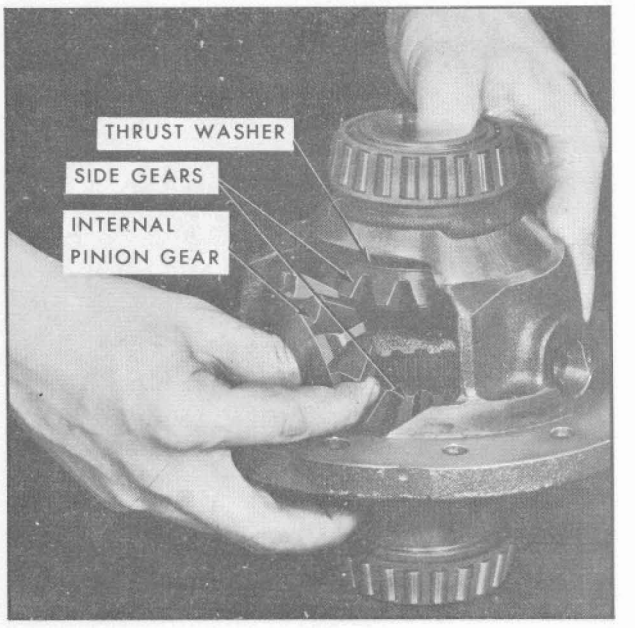


Fig. 4-71 Removing and Installing Internal Gears

13. Remove both side gears and thrust washers, Fig. 4-71.

14. Install Pilot, J-23406, on differential side bearing, Fig. 4-72.

15. Install Puller Legs, J-23345-1, and Puller Bar, J-8433-1, on side bearing and secure assembly in vise, Fig. 4-72.

16. Tighten driver bolt and remove side bearing.

CAUTION: Side bearing and gear case will fall when bearing is removed. If possible, swing vise so that gear case is over the bench. Even a short drop may damage these parts. For this reason, place a piece of thick cardboard on bench. If these safety

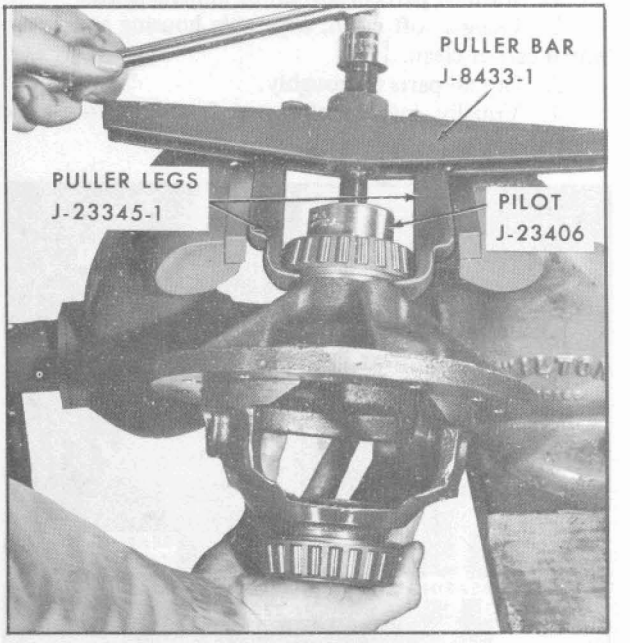


Fig. 4-72 Removing Differential Side Bearings

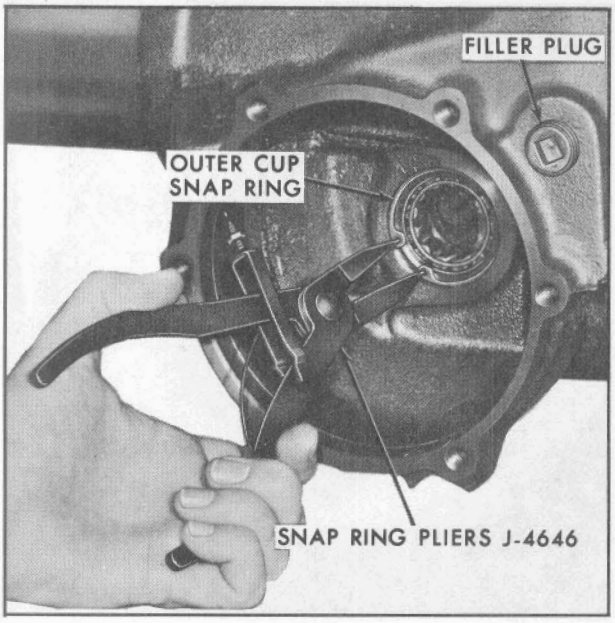


Fig. 4-73 Removing and Installing Straddle Bearing Outer Snap Ring

precautions cannot be followed, grip gear case firmly when removing side bearing.

(IMPORTANT: When removing side bearing, be sure to check position of puller legs several times. Puller legs must remain positioned under side bearing inner race.)

17. Repeat Steps 14, 15, and 16 to remove other side bearing.

j. Cleaning and Inspection of Gear Case Assembly

1. Wash all parts in solvent or mineral spirits.
2. Using a soft cloth, wipe axle housing and differential carrier clean.
3. Dry all parts thoroughly.
4. Visually inspect all parts for chips, nicks, or excessive wear.

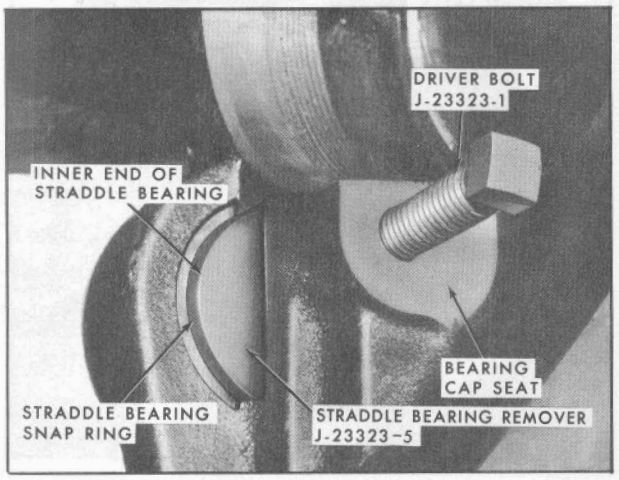


Fig. 4-74 Removing Straddle Bearing

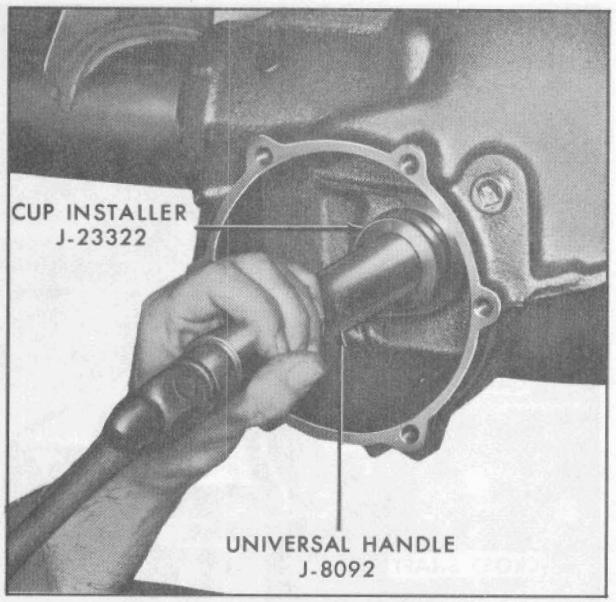


Fig. 4-75 Installing Straddle Bearing Assembly

k. Straddle Bearing Removal

1. Using Snap Ring Pliers, J-4646, remove straddle bearing outer snap ring, Fig. 4-73.
2. Install Straddle Bearing Remover, J-23323-5, Fig. 4-74, centering remover on bearing.
3. Install Driver Bolt, J-23323-2, in bearing cap mounting bolt hole, Fig. 4-74.
4. Tighten driver bolt and remove straddle bearing assembly.

l. Straddle Bearing Installation

1. Attach Universal Handle, J-8092, to Bearing Installer, J-23322, and install straddle bearing and outer race assembly, Fig. 4-75.
2. Using Snap Ring Pliers, J-4646, install outer snap ring to secure straddle bearing outer race in differential carrier, Fig. 4-73.

m. Pinion Assembly

1. Position inner bearing outer cup and Inner

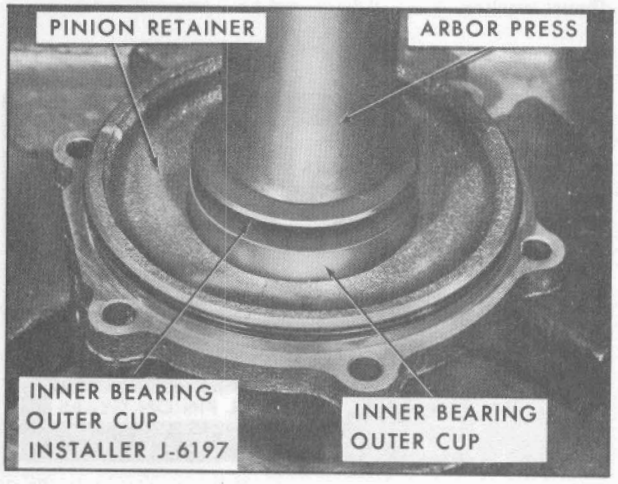


Fig. 4-76 Installing Inner Bearing Outer Cup

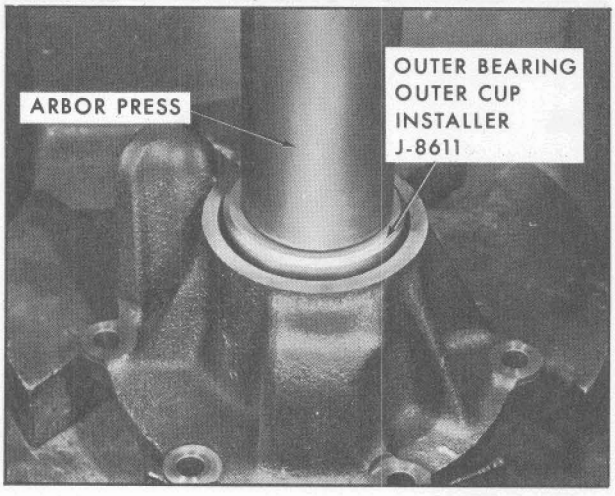


Fig. 4-77 Installing Outer Bearing Outer Cup

Bearing Outer Cup Installer, J-6197, on pinion retainer. Using arbor press, install inner bearing outer cup into retainer, Fig. 4-76.

2. Remove cup installer, and turn retainer over in press.

3. Position outer bearing outer cup and Outer Bearing Outer Cup Installer, J-8611, on retainer. Press outer bearing outer cup into retainer, Fig. 4-77.

4. Lubricate pinion outer bearing with differential lubricant and install outer bearing in retainer.

5. Pack inner lip of new pinion oil seal with wheel bearing lubricant.

6. Position oil seal on retainer, Fig. 4-78. Place Oil Seal Installer, J-23318, against seal.

7. Carefully press oil seal into pinion retainer.

(NOTE: When properly installed, oil seal should protrude approximately 1/16".)

8. Remove oil seal installer.



Fig. 4-78 Installing Pinion Oil Seal

9. Remove staking burrs on pinion shaft threads, using a 7/8" x 14 thread die.

(NOTE: If thread die is not available, use of a triangular file is acceptable.)

10. Apply a light coat of differential lubricant on pinion inner bearing.

11. Using Bearing Installer, J-23314, and arbor press, install inner bearing on pinion shaft, Fig. 4-79.

12. Remove pinion shaft from press.

13. Install a new collapse spacer on pinion shaft.

14. With pinion shaft and retainer on bench, insert pinion shaft through retainer and position pinion flange on shaft using alignment marks made on disassembly.

15. Install pinion nut washer and new pinion nut and tighten with fingers.

(NOTE: If flange did not slip on far enough to start nut and washer, tap gently with a soft hammer until nut can be started.)

16. Install Spacers, J-21044-5, over unthreaded holes in pinion flange.

17. Install Pinion Flange Holding Tool, J-8614-1, with raised side of tool against spacers. Secure holding tool with 3/8" bolts and nuts, Fig. 4-59.

18. Attach Torque Multiplier, J-23410, to 1-1/4" socket and install on pinion nut. Attach Torque Multiplier Link, J-23413, Fig. 4-59.

19. Install breaker bar on torque multiplier.

20. Tighten pinion nut only until all end play has been removed.

21. Remove breaker bar, torque multiplier and link, holding tool, bolts, nuts, and spacers and check flange runout as follows:

a. Remove one pinion retainer screw from holding fixture and install Dial Indicator, J-8001, and Support J-6126 so that stem touches flange between bolt holes and pilot diameter at a 90° angle, as shown in Fig. 4-57. Set dial to zero.

b. Rotate pinion flange one complete revolution in each direction and note maximum reading obtained for face runout.

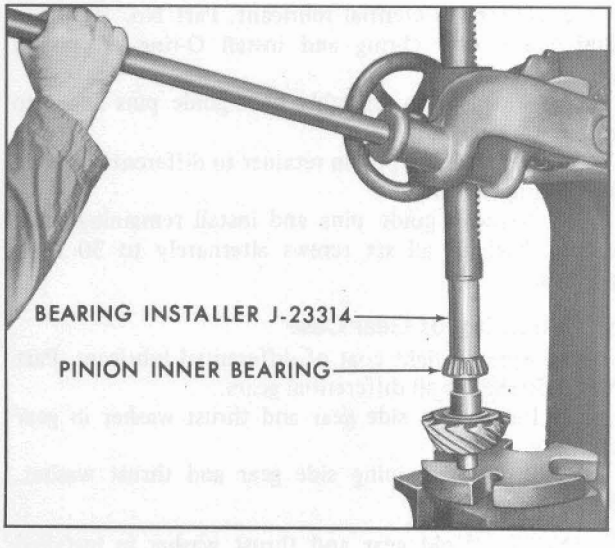


Fig. 4-79 Installing Pinion Inner Bearing

c. Install Dial Indicator Extension, J-7057, on dial indicator, and reposition indicator so that stem touches side of pinion flange pilot diameter, Fig. 4-58.

d. Rotate pinion flange one complete turn in each direction. Note maximum radial runout. If combined face and radial runout is .005" or less, proceed to Step 23.

22. If combined runout exceeds .005", remove and re-index pinion flange 90° from its original position on pinion shaft splines. Install pinion nut and washer until end play is removed and recheck runout. If runout still exceeds specification, remove and re-index 180° and check runout. If runout is still unacceptable, replace pinion flange and check runout of new flange.

23. After end play is removed, and runout is within specification, build preload in the pinion by the following procedure:

a. Tighten pinion nut no more than 1/8 of a flat.

b. Remove torque wrench, torque multiplier and torque multiplier link.

c. Insert 50 inch-pound torque wrench and 1-1/4 inch socket on pinion nut and turn two revolutions in each direction. If new bearings are installed, preload reading should be 22-30 inch-pounds. If original bearings are used, set preload to 5 inch-pounds more than original reading, but not more than 15 inch-pounds total.

d. If reading is under these specifications, continue tightening, but never tighten more than 1/8 of a flat without checking preload.

CAUTION: After end play has been removed, preload will build very quickly. If the preload specification is exceeded, it will be necessary to disassemble the pinion again, and install another new collapse spacer. Never back off pinion nut to gain the proper preload.

24. After proper preload reading is obtained, remove all tools from pinion assembly and stake pinion shaft into pinion nut.

n. Installation of Pinion Assembly

1. Install original shim(s) over guide pins in differential carrier.

2. Using differential lubricant, Part No. 1050189, lubricate a new O-ring and install O-ring on pinion retainer.

3. Slide pinion assembly over guide pins and into differential carrier.

4. Install three pinion retainer to differential carrier screws finger tight.

5. Remove guide pins and install remaining three screws. Tighten all six screws alternately to 30 foot-pounds.

o. Assembly of Gear Case

1. Apply a light coat of differential lubricant, Part No. 1050189, to all differential gears.

2. Install one side gear and thrust washer in gear case, Fig. 4-71.

3. Install remaining side gear and thrust washer, Fig. 4-71.

(NOTE: Hold gear and thrust washer in installed position.)

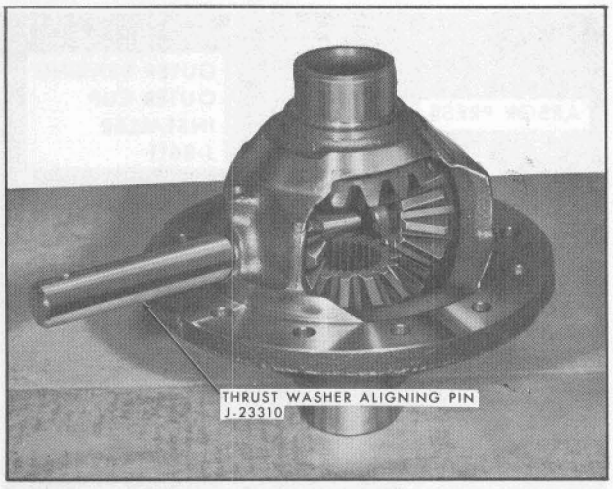


Fig. 4-80 Aligning Internal Gears and Thrust Washers

4. Install one pinion gear and thrust washer in each gear case opening, Fig. 4-71.

5. Rotate differential pinion gears and thrust washers so that cross shaft holes align with cross shaft opening in gear case, Fig. 4-70.

6. Slide Side Gear Aligning Pin, J-23310, through differential gears and thrust washers to align gears and washers, Fig. 4-80.

7. Install differential cross shaft and align hole in cross shaft with roll pin hole in differential gear case, Fig. 4-81.

8. Install roll pin on counterbore side of roll pin opening with a 1/4" diameter punch until top of roll pin aligns with bottom of counterbore.

9. Install Guide Pins, J-23316-1, in ring gear.

10. Using alignment marks made on disassembly, align ring gear with gear case and position ring gear on case.

11. Install nine ring gear to differential gear case screws finger tight.

(NOTE: These screws have left hand threads.)

12. Using a soft mallet, tap ring gear down onto gear case.

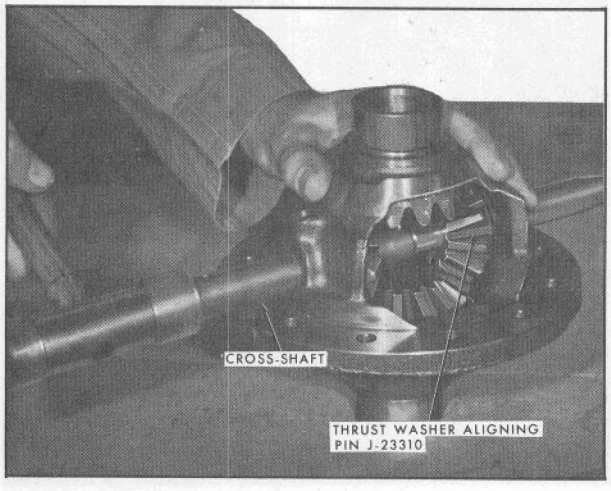


Fig. 4-81 Installing Cross Shaft

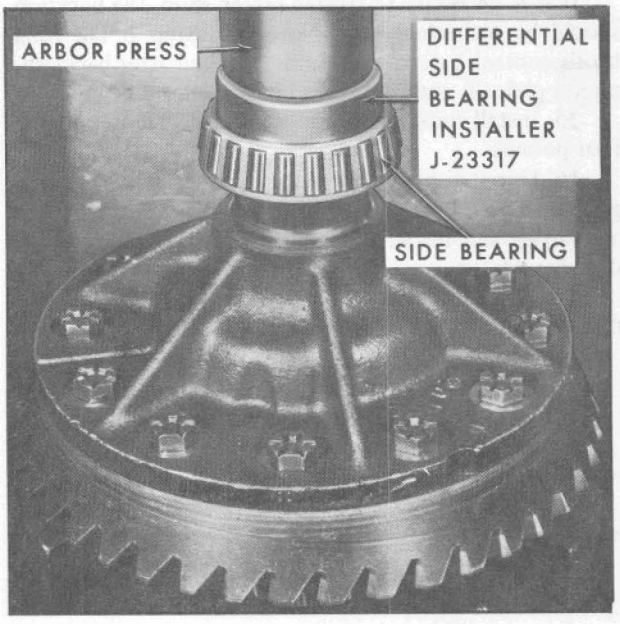


Fig. 4-82 Installing Side Bearings

13. Remove guide pins and install remaining three screws.

14. Install differential gear case on Holding Fixture J-23372, Fig. 4-67.

15. Alternate tightening ring gear screws to 85 foot-pounds.

16. Position one side bearing and Side Bearing Installer, J-23317, on gear case, Fig. 4-82.

17. Use arbor press to install side bearing.

18. Repeat Steps 16 and 17 to install remaining side bearing.

p. Gear Case Installation

1. Install bearing cups on differential side bearings. Cups will have to be held in place when installing gear case into carrier, Fig. 4-66.

(NOTE: Make sure wider bearing cup is installed in differential left side bearing, which is the shim side of the unit.)

2. Install gear case assembly into differential carrier.

3. Install differential case adjuster nut, Fig. 4-83.

CAUTION: Make sure adjuster nut threads are properly aligned with threads in differential carrier.

4. Install right side bearing cap and install two cap mounting screws. Do not tighten bolts at this time.

5. Align bearing cap threads with adjuster nut threads by pulling cap straight back on mounting screws and then gently pushing cap forward and into position.

(NOTE: Bearing cap and adjuster nut threads are properly aligned when bearing cap and carrier shoulder are flush. Adjuster nut should turn freely.)

6. Tighten bearing cap mounting screws to 50 foot-pounds.



Fig. 4-83 Installing Adjuster Nut

7. Slide differential gear case to extreme right so that ring gear and pinion gear teeth are fully engaged.

8. Slide left side bearing and cup to right and insert original side bearing shim, with beveled side of shim to left, Fig. 4-84.

9. Tighten adjuster nut by hand until it makes contact with right side bearing.

10. Install left bearing cap and tighten mounting screws with fingers.

11. Obtain proper case spread by the following procedure:

a. Install Dial Indicator, J-8001, and Tools J-23409-1 and J-23409-2 on differential carrier, Fig. 4-65.

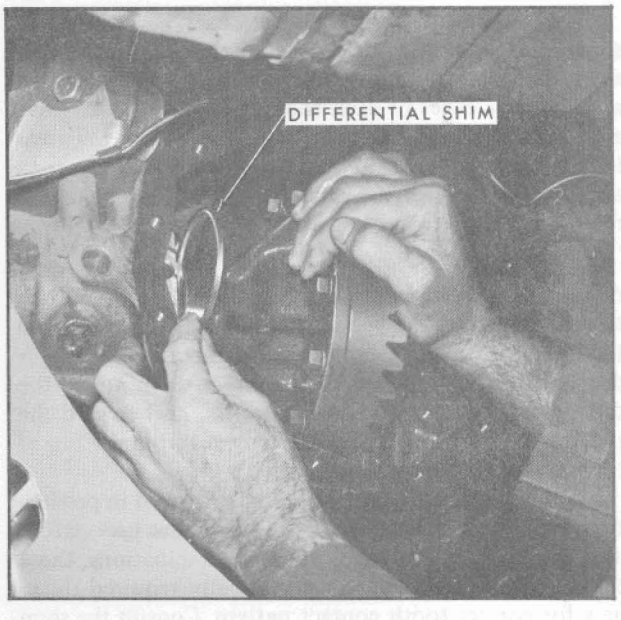


Fig. 4-84 Installing Side Bearing Shim

b. Position button on indicator so that it rests against inside face of Plate, J-23409-2, then set dial to zero.

c. Using Spanner Wrench, J-23398, tighten adjuster nut until reading of .003" to .004" is obtained. Rotate ring gear at least one complete revolution. If case spread reading has fallen, resume tightening adjuster nut until reading of .003" to .004" is obtained. Rotate and tighten as necessary until continuous reading within these specifications is attained.

(NOTE: Do not hit or bump dial indicator during this step. If indicator is disturbed in any way, adjuster nut must be backed off and procedure must be repeated.)

12. Tighten left bearing cap mounting bolts to 50 foot-pounds.

13. Reposition dial indicator and check ring gear to pinion backlash, Note 43c, Step 2, and Fig. 4-52.

(IMPORTANT: Original backlash reading must be duplicated on any ring and pinion gear set that has been in use more than approximately 3000 miles. Backlash of from .005" to .010" should be obtained on lower mileage gear sets. If reading is too high, increase shim size. If reading is too low, decrease shim size. A .002" shim change will generally change backlash by .001". Recheck backlash after each shim change. If variation between three backlash readings evenly spaced around the ring gear exceeds .003", correct this condition by following procedure of Note 44 before proceeding to Step 14.)

14. Paint all ring gear teeth with special yellow gear marking compound. Obtain tooth pattern by rotating ring gear at least one revolution in each direction, using a box end wrench on the ring gear screws. Put a load on the pinion assembly during this operation by wrapping a shop cloth around pinion flange and holding cloth tightly. Compare pattern with samples, Fig. 4-55.

(NOTE: The Tooth Pattern Chart is designed to show the perfect tooth contact pattern and the minimum allowable distances between the pattern obtained and the four edges of each tooth. Patterns of both drive and coast sides of gear teeth must fall within the areas indicated. If either drive or coast pattern falls closer to an edge than any of the samples, pinion shim change is required.)

An increase in the thickness of the pinion shim moves the drive side pattern from the root of the toe toward the top of the heel; the coast pattern moves from the root of the heel toward the top of the toe. A decrease in the thickness of the pinion shim moves the drive side pattern from the top of the heel toward the root of the toe; the coast pattern moves from the top of the toe toward the root of the heel.

Although 21 different size shims are used in production, only three sizes are provided for service use: .010", .007", and .006". Used in various combinations, these three sizes are sufficient to provide any required thickness for correct tooth contact pattern. Consult the shim chart on Page 4-62 for a list of combinations.

If it is necessary to change pinion shim, the backlash should be rechecked as in Note 43c, Step 2. The final tooth contact pattern should be checked after backlash, pinion preload, and case spread have been set.

15. Install lock tab on adjuster nut. Tighten to 18 foot-pounds.

16. Using a new differential carrier cover gasket, position brake line clamp, gasket, and differential cover on carrier and install 12 screws. Tighten screws to 30 foot-pounds.

q. Completion of Rear Axle Assembly

1. Install axle shafts as described in Note 37d.
2. Install differential carrier nose bumper arm with two screws and lockwashers. Tighten to 50 foot-pounds.
3. Install propeller shaft and remove propeller shaft support chain.
4. Refill rear axle to correct level with rear axle lubricant, Part No. 1050189.

(NOTE: Fluid level is correct when even with lower lip of the filler hole.)

5. Install differential filler plug, tightening to 25 foot-pounds.
6. Install brake drums and bleed brakes.
7. Install both rear wheels. Snug wheel mounting nuts.
8. Lower car.
9. Tighten wheel mounting nuts to 105 foot-pounds. *(See CAUTION on Page 4-3.)*
10. Install wheel discs and wheel shields.

44. Correction of Excessive Backlash Variance

1. Remove gear case assembly from carrier housing.
2. Remove ring gear from gear case. Check for any dirt or foreign particle that may have been trapped between ring gear and carrier. This is the most likely cause of backlash variance. Surface between ring gear and carrier must be absolutely clean.
3. Replace gear case in housing without ring gear.

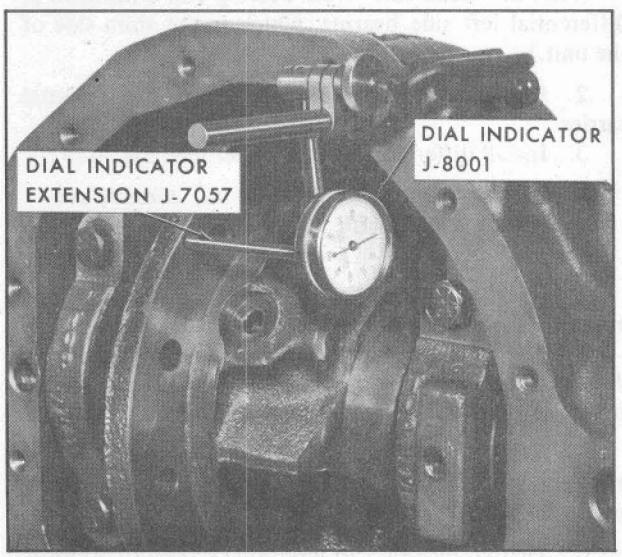


Fig. 4-85 Checking Gear Case Runout

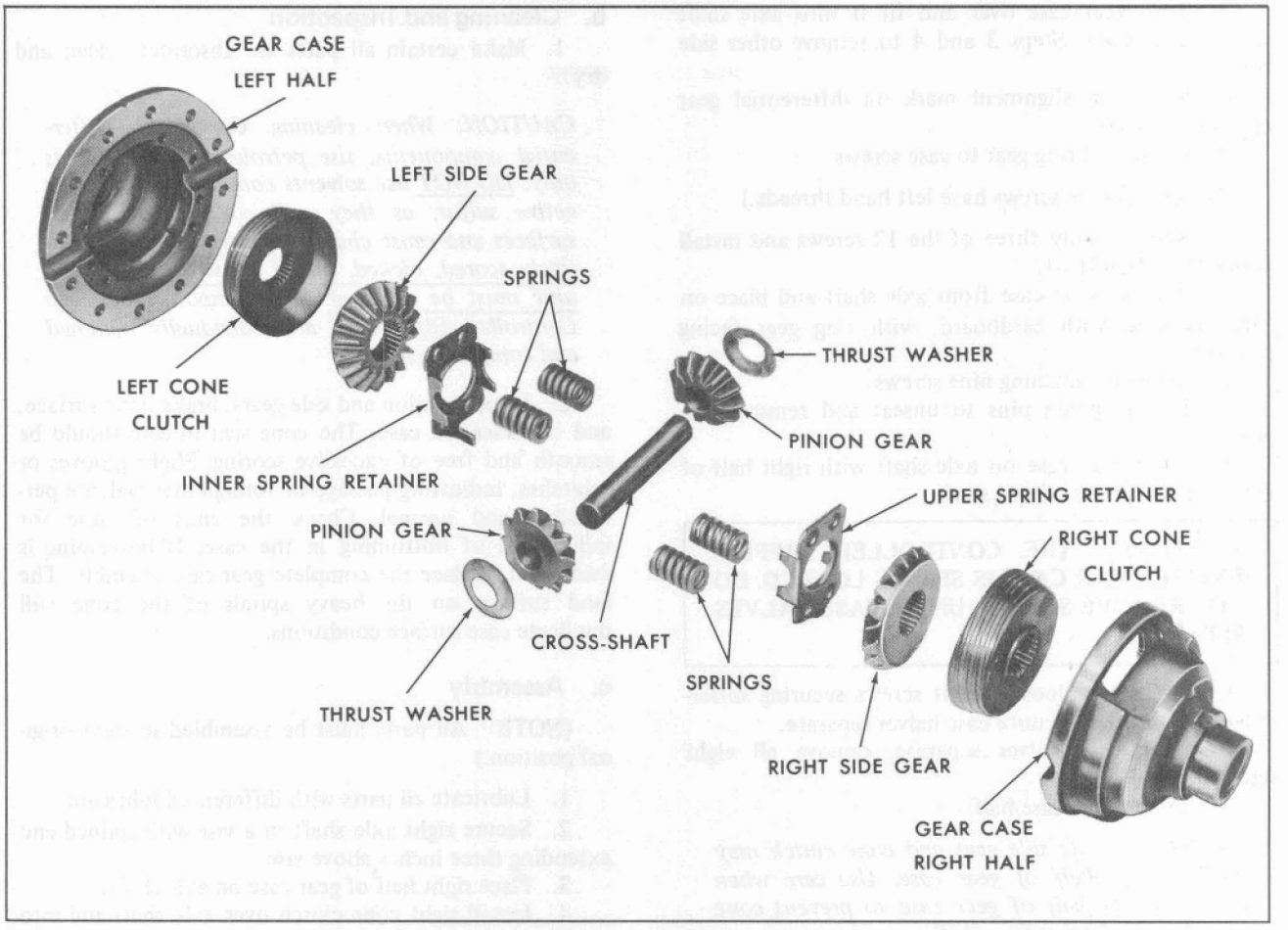


Fig. 4-86 Controlled Differential - Disassembled

Use dial indicator to check runout of gear case, Fig. 4-85. If runout exceeds .003", replace gear case.

4. If gear case runout is less than .003", replace ring gear and pinion gear.

(NOTE: If backlash variance is only slightly above specification, .0035" for example, and gear case runout accounts for only part of the total, for instance .002", re-index ring gear 180° from its original position on gear case and test backlash variance. If this is still greater than .003", re-index ring gear another 90° and test again for backlash variance.)

45. Controlled Differential (Fig. 4-86)

The Controlled Differential assembly is serviced only as a unit. Disassembly of the Controlled Differential is intended only for cleaning and inspection of the gear case and its components in the event of a bearing or gear set failure. If any of the parts show signs of excessive scoring, pitting, or wear, the entire unit must be replaced.

(IMPORTANT: When disassembling the Controlled Differential gear case, lay the parts out in the order in which they are removed from the gear case. This is necessary, as the parts are installed as matched sets at time of original assembly.)

a. Disassembly

1. Secure one axle shaft in a vise with splined end of shaft extending three inches above top of vise.

2. Insert gear case on axle shaft.

3. Install Pilot, J-23406, in differential case side bearing, Fig. 4-87.

4. Using Bearing Puller, J-22888-1, remove differential case side bearing, Fig. 4-87.

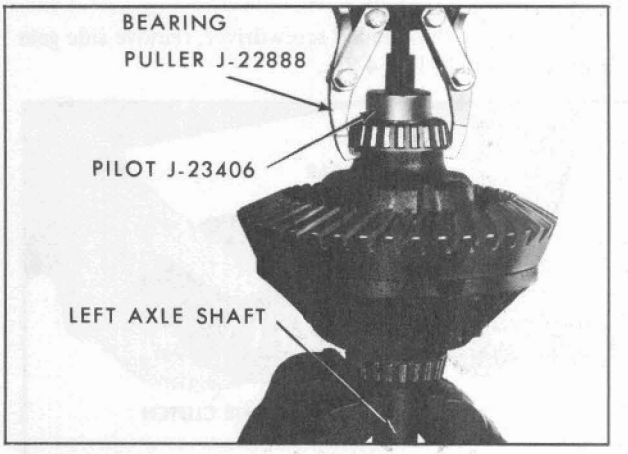


Fig. 4-87 Removing Side Bearings (Controlled)

5. Turn gear case over and fit it into axle shaft splines and repeat Steps 3 and 4 to remove other side bearing.

6. Scribe an alignment mark on differential gear case and ring gear.

7. Loosen 12 ring gear to case screws.

(NOTE: These screws have left hand threads.)

8. Remove only three of the 12 screws and install Guide Pins, J-23316-1.

9. Remove gear case from axle shaft and place on table covered with cardboard, with ring gear facing downward.

10. Remove remaining nine screws.

11. Tap on guide pins to unseat and remove ring gear.

12. Insert gear case on axle shaft with right half of gear case on splines of axle shaft.

WARNING: THE CONTROLLED DIFFERENTIAL GEAR CASE IS SPRING LOADED. DO NOT REMOVE SCREWS UNTIL CASE HALVES SEPARATE.

13. Alternately loosen eight screws securing differential gear case halves until case halves separate.

14. After case halves separate, remove all eight screws.

15. Remove left case half.

CAUTION: Left side gear and cone clutch may stick in left half of gear case. Use care when removing left half of gear case to prevent cone clutch and side gear from falling.

16. Using a thin bladed screwdriver, remove left side gear from cone clutch, Fig. 4-88.

17. Remove upper spring retainer from unit, Fig. 4-89.

18. Lift cross shaft to unseat shaft from lock pin, and remove cross shaft, pinion gears, and pinion gear thrust washers, Fig. 4-70.

19. Remove differential cross shaft lock pin.

20. Remove four springs.

21. Remove lower spring retainer.

22. Remove remaining cone clutch and side gear from right gear case half.

23. Using a thin bladed screwdriver, remove side gear from cone clutch, Fig. 4-88.

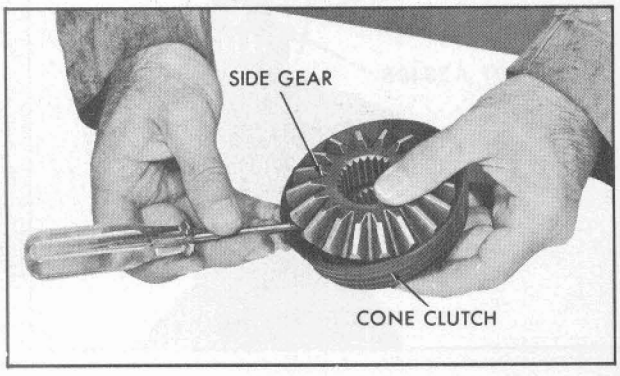


Fig. 4-88 Separating Side Gear and Cone Clutch

b. Cleaning and Inspection

1. Make certain all parts are absolutely clean and dry.

CAUTION: When cleaning Controlled Differential components, use petroleum base solvents only. DO NOT use solvents containing chlorine or active sulfur, as they will contaminate clutch surfaces and cause chatter. If any parts are excessively scored, nicked, pitted, or worn, the entire unit must be replaced. The components of the Controlled Differential are individually matched and comprise a set.

2. Inspect pinion and side gears, brake cone surface, and cone seat in case. The cone seat in case should be smooth and free of excessive scoring. Slight grooves or scratches, indicating passage of foreign material, are permissible and normal. Check the ends of cone for indications of bottoming in the case. If bottoming is evidenced, replace the complete gear case assembly. The land surface on the heavy spirals of the cone will duplicate case surface conditions.

c. Assembly

(NOTE: All parts must be assembled in their original position.)

1. Lubricate all parts with differential lubricant.

2. Secure right axle shaft in a vise with splined end extending three inches above vise.

3. Place right half of gear case on axle shaft.

4. Install right cone clutch over axle shaft and into right half of gear case.

5. Install right side gear over axle shaft and into right cone clutch.

6. Install inner spring retainer and springs in right half of gear case with the tab on retainer opposite opening in gear case, Fig. 4-89.

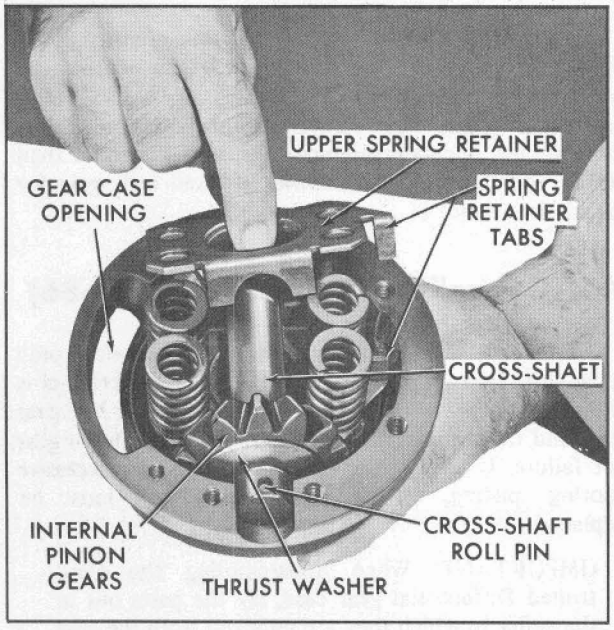


Fig. 4-89 Removing and Installing Upper Spring Retainer

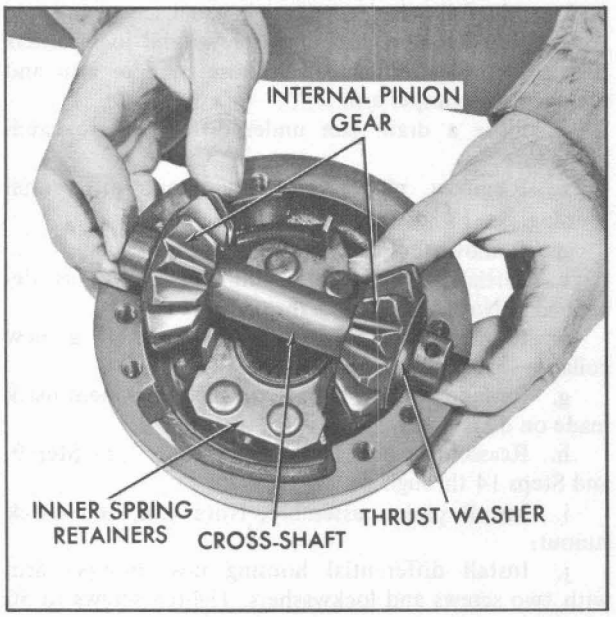


Fig. 4-90 Removing and Installing Pinion Gears, Cross Shaft, and Thrust Washers

(NOTE: After spring retainer and springs are installed, check to make sure springs are properly seated on spring retainer seats.)

7. Install pinion gears and thrust washers on cross shaft.
8. Install cross shaft lock pin in hole in right half of gear case.
9. Install cross shaft, pinion gears, and thrust washers in right half of gear case, Fig. 4-90.

(NOTE: Make sure cross shaft is properly seated on lock pin.)

10. Install upper spring retainer with tab on retainer opposite opening in gear case and aligned with tab on other retainer, Fig. 4-89.

(NOTE: After retainer is installed, check to make sure that spring seats on retainer are centered in the springs.)

11. Position left side gear on upper spring retainer.
12. Install left cone clutch on left side gear, making sure splines in cone clutch align with splines in left side gear.
13. Position left half of gear case on right half.
14. Install eight gear case screws finger tight.
15. Install left axle shaft in gear case to align splines in left cone clutch with splines in left side gear.
16. Leaving left axle shaft in place, alternate tightening gear case screws to 30 foot-pounds, Fig. 4-91.
17. Remove left axle shaft from gear case.

(NOTE: It may be necessary to tap on axle shaft with a soft mallet to permit removal of shaft from gear case.)

18. Remove gear case from axle shaft secured in vise.
19. Install Guide Pins, J-23316-1, in ring gear.

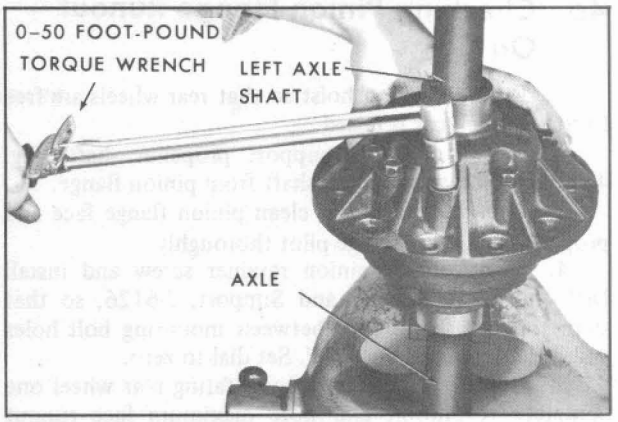


Fig. 4-91 Tightening Gear Case Screws (Controlled)

20. Using alignment marks made on disassembly, align ring gear case and position ring gear on case.
21. Install nine ring gear to differential gear case screws finger tight.

(NOTE: These screws have left hand threads.)

22. Using a soft mallet, tap ring gear down onto gear case.
23. Remove guide pins and install remaining three screws.
24. Install gear case on axle shaft with ring gear facing downward.
25. Alternate tightening ring gear screws to 85 foot-pounds.
26. Remove gear case from axle shaft.
27. Position bearing and Side Bearing Installer, J-23317, and using arbor press, install side bearing on gear case, Fig. 4-92.
28. Repeat Step 27 to install remaining side bearing.

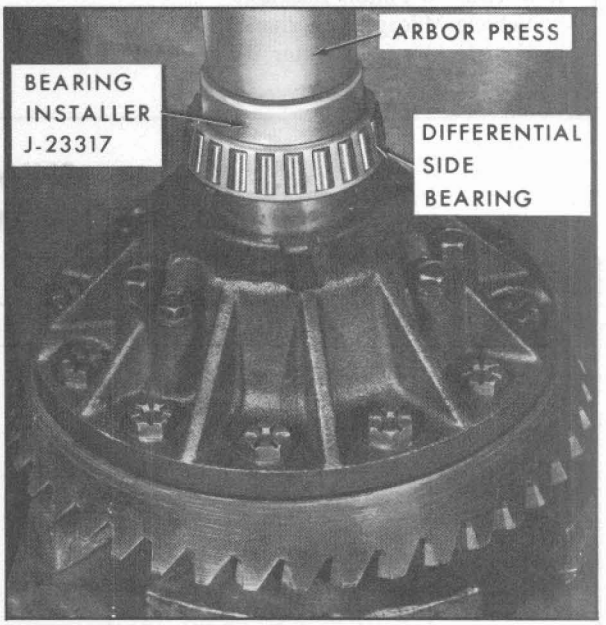


Fig. 4-92 Installing Differential Side Bearings (Controlled)

46. Checking Pinion Flange Runout—On Car

1. Position car on hoist so that rear wheels are free to rotate when car is raised.

2. Install chain to support propeller shaft, Fig. 4-25, and remove propeller shaft from pinion flange.

3. Using a wire brush, clean pinion flange face and propeller shaft rear flange pilot thoroughly.

4. Remove one pinion retainer screw and install Dial Indicator, J-8001, and Support, J-6126, so that stem touches flange face between mounting bolt holes and pilot diameter, Fig. 4-57. Set dial to zero.

5. Rotate pinion flange by rotating rear wheel one complete revolution and note maximum face runout reading.

6. Install Dial Indicator Extension, J-7057, on dial indicator, and reposition indicator so that stem touches side of pinion flange pilot diameter, Fig. 4-58.

7. Repeat Step 5 to find radial runout. Combined face and radial runout should not exceed .005". Remove dial indicator apparatus and install pinion retainer screw.

8. If runout is satisfactory, re-attach propeller shaft, remove propeller shaft support chain, and lower car.

9. If combined runout is not within specification, perform the following procedure in exact sequence:

a. Remove two attaching screws and lockwashers that secure differential carrier nose bumper arm and remove nose bumper arm.

b. Place a drain pan under differential to catch lubricant.

c. Remove pinion assembly from differential housing, Note 43d, Steps 1 through 7.

d. Remove and discard pinion retainer O-ring.

e. Partially disassemble pinion assembly as described in Note 43f, Steps 2 through 11.

f. Remove collapse spacer and install a new collapse spacer on pinion shaft.

g. Re-index pinion flange 90° using alignment mark made on disassembly.

h. Reassemble pinion, following Note 43m Step 9, and Steps 14 through 24.

i. Install pinion assembly, Note 43n, and check runout.

j. Install differential housing nose bumper arm with two screws and lockwashers. Tighten screws to 50 foot-pounds.

k. Install propeller shaft and remove propeller shaft support chain.

l. Lower car.

SPECIFICATIONS

Pinion Flange Combined Face and Radial Runout	.005"
Gear Case Spread	.003" – .004"
Pinion Bearing Preload	
Used Bearings	5 inch-pounds higher than reading found on disassembly, but no higher than 15 inch-pounds total.
New Bearings	22–30 Inch-Pounds
Ring Gear to Pinion Backlash	
Vehicle Mileage Less than 3000	.005" – .010"
Vehicle Mileage Greater than 3000	Re-establish Reading Found on Disassembly

SHIM CHART
PINION SHIM COMBINATIONS

Prod. Size	Service Sizes			Prod. Size	Service Sizes		
	.010	.007	.006		.010	.007	.006
.016	1		1	.027	2	1	
.017	1	1		.028	1		3
.018			3	.029	1	1	2
.019		1	2	.030	3		
.020	2			.031	1	3	
.021		3		.032	2		2
.022	1		2	.033	2	1	1
.023	1	1	1	.034	2	2	
.024	1	2		.035	1	1	3
.025		1	3	.036	3		1
.026	2		1				

SIDE BEARING SHIMS

Size	Color	No. of Stripes	Size	Color	No. of Stripes
.1015	Yellow	1	.1185	White	3
.1025	Yellow	2	.1195	White	4
.1035	Yellow	3	.1205	White	5
.1045	Yellow	4	.1215	Green	1
.1055	Yellow	5	.1225	Green	2
.1065	Orange	1	.1235	Green	3
.1075	Orange	2	.1245	Green	4
.1085	Orange	3	.1255	Green	5
.1095	Orange	4	.1265	Pink	1
.1105	Orange	5	.1275	Pink	2
.1115	Blue	1	.1285	Pink	3
.1125	Blue	2	.1295	Pink	4
.1135	Blue	3	.1305	Pink	5
.1145	Blue	4	.1315	Black	1
.1155	Blue	5	.1325	Black	2
.1165	White	1	.1335	Black	3
.1175	White	2	.1345	Black	4

TORQUE SPECIFICATIONS

Material No.	Application	Size	Foot-Pounds
300-M	Bearing Cap Bolts	7/16–14	50
300-M	Ring Gear-to-Gear Case Bolts	7/16–20	85
280-M	Pinion Retainer-to-Carrier	3/8–16	30
300-M	Gear Case Bolts (Controlled)	5/16–18	30
Special	Carrier Rear Cover Screws	5/16–18	30
275-M	Adjuster Nut Lock Tab Screw (Screw and Washer Assembly).	5/16–18	18
286-M	Pinion Nut	7/8–14	See Pinion Assembly
300-M	Differential Carrier Nose Bumper Arm	7/16–14	50
300-M	Pinion Flange to Universal Joint Flange Attaching Screws	7/16–20	70*

(NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings, and steel classifications.)

**CAUTION: These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

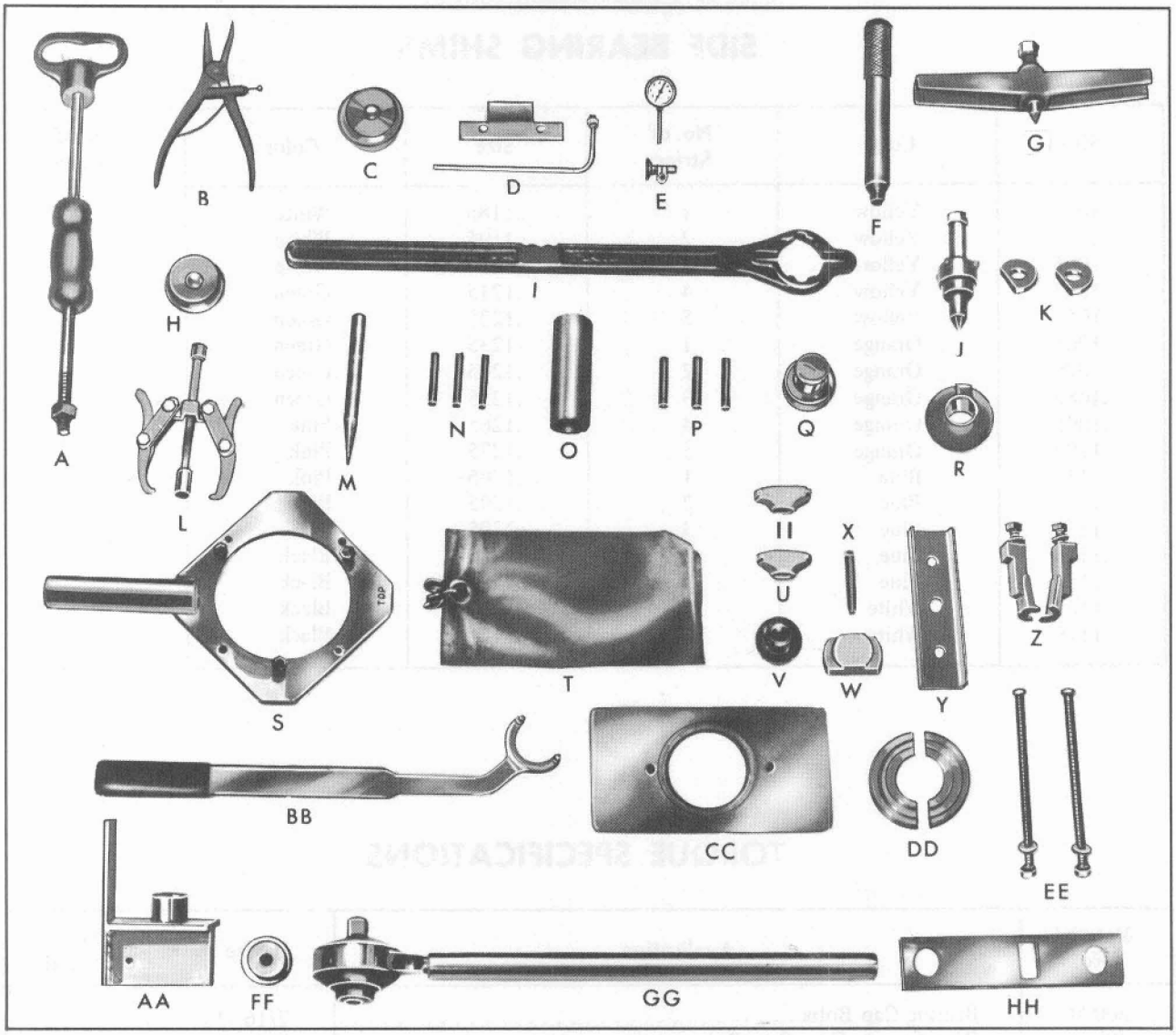


Fig. 4-93 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-2619	Slide Hammer	R	J-23318	Pinion Oil Seal Installer
B	J-4646	Snap Ring Pliers	S	J-23320	Holding Fixture
C	J-6197	Pinion Inner Bearing Cup Installer	T	J-23320-1	Retaining Bag
D	J-23409	Dial Indicator Extension and Support	U	J-23321	Pinion Inner Bearing Cup Remover
E	J-8001	Dial Indicator	V	J-23322	Straddle Bearing Installer
F	J-8092	Universal Handle	W	J-23323-5	Straddle Bearing Remover
G	J-8433-1	Puller Bar	X	J-23323-2	Driver Bolt
H	J-8611-1	Pinion Bearing Cup Installer (Outer)	Y	J-23324	Pinion Puller
I	J-8614-1	Pinion Flange Holding Tool	Z	J-23345-1	Bearing Puller Legs
J	J-8614-2	Pinion Flange Puller	AA	J-23372	Holding Tool
K	J-21044-5	Spacers	BB	J-23398	Spanner Wrench
L	J-22888-1	Side Bearing Puller (Controlled)	CC	J-23399-1	Bearing Plate
M	J-23310	Side Gear Aligning Pin	DD	J-23399-2	Bearing Puller
N	J-23311	Pinion Retainer Guide Pin Set	EE	J-23399-4	Bolts
O	J-23314	Pinion Inner Bearing Installer	FF	J-23406	Side Bearing Pilot
P	J-23316-1	Ring Gear Guide Pins	GG	J-23410	Torque Multiplier
Q	J-23317	Side Bearing Installer	HH	J-23413	Torque Multiplier Link
			II	J-23671	Pinion Outer Bearing Cup Remover

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THEORY OF OPERATION

(NOTE: For information pertaining specifically to the Eldorado brake system, refer to the later portion of this section.)

The braking system consists of power-assisted, hydraulically-operated front and rear service brakes and a foot-operated, vacuum-released parking brake that applies the brake shoes at the rear wheels through mechanical linkage.

Single piston sliding caliper front disc brakes and rear drum brakes are installed on all cars.

Single Piston Sliding Caliper Front Disc Brakes (Fig. 5-1)

The major components of the single piston sliding caliper front disc brake mechanism are the hub and disc assembly, the caliper assembly, the shoe and lining assemblies and the splash shield. The hydraulic system also utilizes a combination valve.

a. Hub and Disc Assembly

The cast iron disc is fully ventilated with 40 cooling fins cast integrally between the machined braking surfaces. When the wheel is in motion, the rotation of the disc fins increases the air circulation for more efficient cooling of the unit. This disc is protected from cross-car splash by a shield on the inboard side. The disc is grooved on both sides to decrease brake noise.

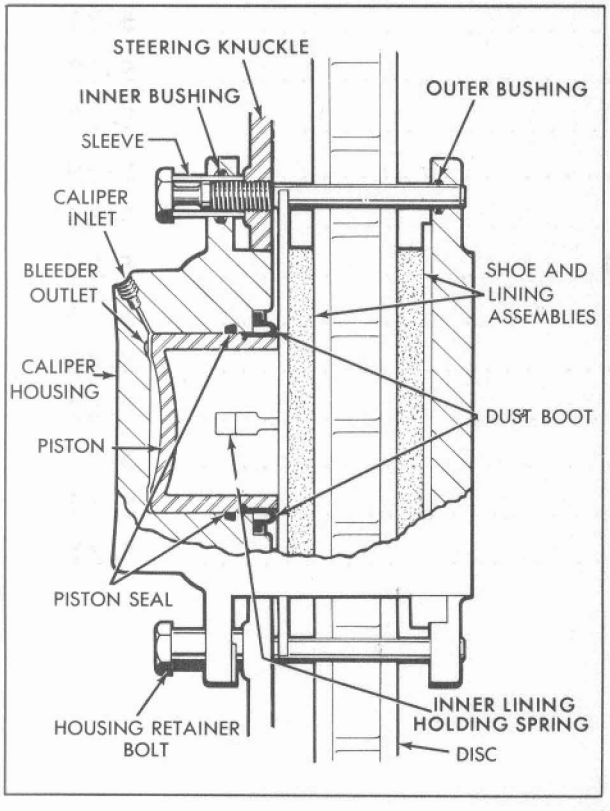


Fig. 5-1 Caliper Cut-Away View

b. Caliper Assembly

The caliper provides a means of applying the shoe and lining assemblies to the disc. It is hydraulically connected to the system by a tube and flexible hose leading from the combination valve to each caliper inlet port. It is mounted to the integral steering knuckle by two housing retainer bolts, two sleeves and four rubber bushings. An inner caliper bushing is installed between each sleeve and groove in the housing, and an outer caliper bushing is installed between each bolt and groove in the housing. Inner and outer shoes and lining assemblies are positioned on the caliper so they straddle the disc.

The one-piece caliper housing is an iron casting that is bored for a single 2-15/16 inch piston and counterbored for a dust boot. A canted groove machined in the cylinder bore accepts a square cut seal that provides a hydraulic seal between the piston and cylinder wall.

The piston is grooved to accept the molded rubber dust boot that provides protection from contamination of the piston and cylinder wall. The boot inner diameter seats on a groove in the piston and the outer diameter is secured to the caliper housing counterbore by a metal ring retainer that is molded in the boot.

When the brake pedal is depressed, hydraulic pressure is exerted within the housing bore equally in all directions. In the single piston mechanism, hydraulic pressure acts on two surfaces causing them to move.

The first is the piston: the second is in the opposite direction against the bottom of the caliper housing bore. Since the area of the piston and bottom of the caliper bore are equal, equal forces are developed.

Hydraulic force in the bore is exerted against the piston and is transmitted to the inner brake shoe and lining assembly and the inner surface of the disc.

The disc is laterally stationary in relation to the steering knuckle. At the same time, an equal hydraulic force presses against the bottom of the bore of the caliper housing. This tends to pull the caliper assembly inboard, sliding on the two pins. The outer lining, which rests on the caliper housing, then applies a force on the outer surface of the disc and together the two linings brake the car.

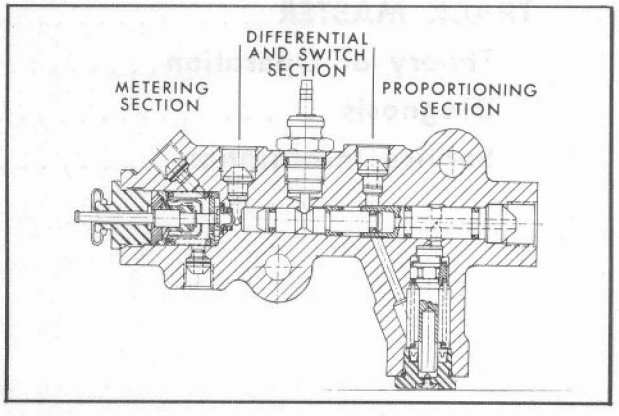


Fig. 5-2 Brake Combination Valve

c. Brake Combination Valve (Fig. 5-2)

The combination valve is located on the frame side rail extension at the left side of the car. It is connected to the master cylinder by two lines. Two rear lines lead to the caliper assemblies and the front line leading to the rear wheel cylinders. The combination valve incorporates three functions as follows:

1. The metering valve (rear portion) incorporates lines leading to the caliper assemblies. The metering valve section delays the application of the disc brakes until the rear brakes are applied to provide a balanced braking during mild stops.

2. The pressure differential section monitors the front and rear brake systems to measure any difference in pressure. If a sufficient pressure differential exists between the systems (100-300 psi), an electrical ground is made energizing the BRAKE tell tale on the right side of the instrument cluster if the ignition switch is on. This light is also energized during engine cranking for bulb and circuit checking purposes.

3. The proportioning valve section limits fluid pressure to the rear wheels at high pressures to provide balanced braking during hard stops.

(NOTE: The brake combination valve on 697 and 698 series does not include the proportioning valve section.)

If a leak occurs in the front system, the pressure differential piston is positioned to allow full line pressure to be transmitted through a bypass channel to the rear wheel cylinders even at high pressures.

Rear Drum Brakes

The rear drum brake system consists of brake shoes (two per wheel) with riveted composition linings acting on cast iron-steel brake drums. The linings are forced against the drums by hydraulic pressure for normal braking and by a foot lever, through a mechanical linkage to the brake shoes, for the parking brake.

The wheel cylinder pistons are made of lubricant-impregnated sintered iron to resist corrosion and sticking. A metal expander is used in each piston cup to reduce the possibility of air entering the system during the application and release of the service brake.

The brake linings are positioned in relation to the brake drums by a stationary non-adjustable anchor on each brake assembly and self-adjusting shoe mechanism. This mechanism and the precision-located anchor insure correct lining-to-drum clearances at all times.

The automatic adjusters can engage when the brakes are applied while the car is moving rearward with light pedal application, or after an uphill stop. Adjustment actually occurs only when there is excessive clearance between the lining and the drum.

The star wheel adjuster assemblies incorporate spring steel thrust washers between the adjusting screw and the adjuster end cap. These washers provide a spring-cushioned contact between the primary and secondary brake shoe, thereby absorbing vibrations that could cause squeak when the brakes are applied.

The brake linings are riveted to the shoes. The primary linings are grooved at the center to permit dissipation of heat from the surface of the brake drum, resulting in better brake performance and longer lining life.

Finned, cast iron-steel brake drums are used on the rear wheels to provide maximum cooling.

The parking brake pedal assembly is mounted on the cowl to the left of the service brake pedal. The parking brake will release automatically when the transmission selector lever is moved into any drive position with the engine running. It will not release automatically, however, with the engine running and the selector lever in Neutral or Park, or in any position with the engine off. A manual release lever, located on the inboard side of the parking brake assembly, may be used if the automatic release is inoperative or if manual release is desired at any time.

The parking brake automatic release mechanism is operated by a vacuum diaphragm assembly. When the transmission selector lever is moved into any drive position with the engine running, a vacuum valve in the neutral switch opens, evacuating air from the diaphragm assembly, which in turn disengages the locking mechanism, permitting the parking brake pedal to return to its released position by spring action.

Tandem Diaphragm Power Brake Unit

The power brake unit used on all cars consists of a tandem diaphragm vacuum power section and a dual hydraulic master cylinder.

The master cylinder is designed so that the front and rear service brakes have separate hydraulic systems. The front section of the master cylinder provides fluid for the front brakes, while the rear section provides fluid for the rear brakes. Should a leak occur in the front hydraulic system, the rear brake system will still function. Likewise, if the rear hydraulic system should develop a leak, then the front system would still function. Increased brake pedal travel and an instrument panel brake light warns the driver that such a condition may have occurred.

The hydraulic unit is completely sealed from the atmosphere by rubber seals in the master cylinder reservoir. Atmospheric pressure acts on one side of the diaphragm type seal and reservoir fluid pressure on the other side. This arrangement permits the seal to follow the level of the brake fluid and prevents moisture absorption or dust contamination.

The tandem diaphragm vacuum power unit has a vacuum power chamber that consists of a front and rear shell, a housing divider, front and rear diaphragm and plate assemblies, a hydraulic push rod, and a diaphragm return spring, Fig. 5-3.

The unit operates so that the two diaphragm and plate assemblies utilize the differential pressure created by engine intake manifold vacuum and atmospheric pressure to assist the hydraulic push rod.

There are several differences between the tandem unit used on 693 series as compared to that used on other models. Therefore, these two units should not be interchanged.

The 693 unit utilizes a shorter push rod and specific calibration.

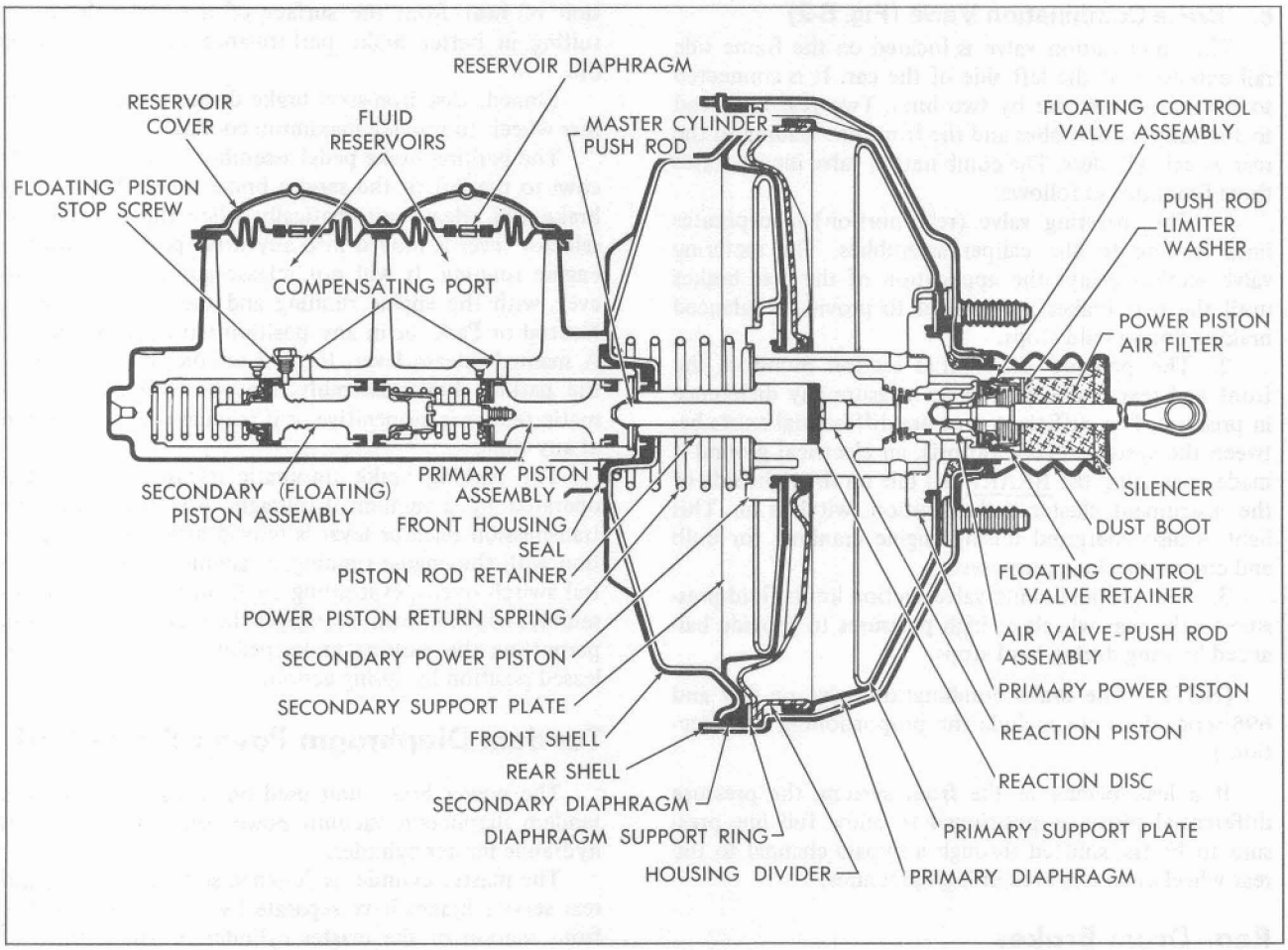


Fig. 5-3 Tandem Diaphragm Power Unit

Brake Stoplight Switch

The brake stoplight switch is mounted on a flange on the brake pedal support bracket below the instrument panel. When the brake pedal is depressed, the spring loaded switch plunger follows the brake pedal arm downward until the switch is in the "on" position. When the brakes are released, the arm returns the switch plunger to the "off" position.

Brake Fluid

It is recommended that Part Number 546 4831 Super Heavy Duty Brake Fluid or equivalent fluids meeting SAE J-1703 specifications be used in Cadillac brake systems.

Brake fluid should always be stored in closed containers, as it will absorb moisture from the atmosphere. Moisture contamination of brake fluid causes the boiling point of the fluid to be lowered.

DIAGNOSIS

1. Testing Brake System

a. Vacuum Power Section

1. Attach one end of spare windshield washer pump inlet hose to the port nearest the shut-off valve of Leak Testing Tool, J-23108, Fig. 5-4.
2. Disconnect power brake hose from vacuum fitting at base of carburetor and attach the other end of the windshield washer pump inlet hose to this fitting. A small amount of silicone lubricant will facilitate installation, Fig. 5-4.
3. Connect the power brake hose to other port of the tester and secure with hose clamp, Fig. 5-4.
4. Run engine at idle for approximately 1/2 minute.
5. Turn off shut-off valve on tee.
6. Note vacuum gage reading.
7. Apply brakes with estimated 20-30 pounds force (the effort required for a moderate stop). While holding pedal force as constant as possible, note vacuum gage reading immediately after applying brake and one-half minute later.

a. Immediate reading should not be more than six inches of mercury less than initial reading taken after closing shut-off valve. Any release of the brake pedal will increase the reading, Subsequent drop in vacuum reading

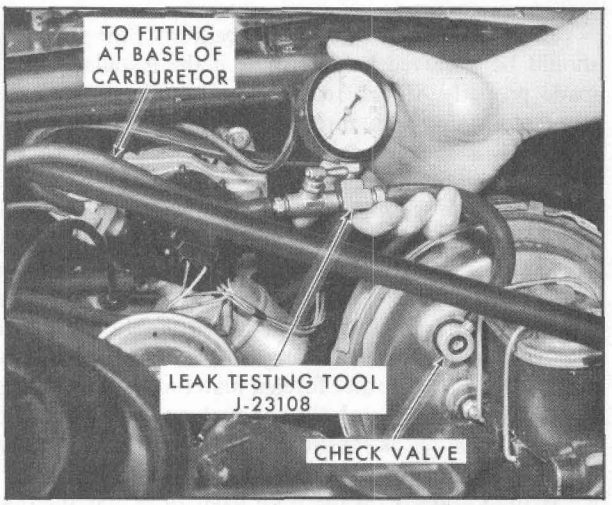


Fig. 5-4 Vacuum Leakage Test

while holding brakes applied should not exceed two inches of mercury per 1/2 minute. If vacuum leak exceeds specification, power unit must be serviced.

b. Master Cylinder Section

(NOTE: These tests will not determine all master cylinder malfunctions. Use the diagnosis chart to help isolate the problem if it is not resolved by these tests.)

1. Check for a cracked master cylinder casting or brake fluid around master cylinder.

Leaks are indicated only if there is at least a drop of fluid. A damp condition is not abnormal.

2. Rapidly depress brake pedal. A geyser should be seen at front reservoir as the brake pedal is rapidly depressed.

a. If system fails this test, check for a binding pedal linkage and incorrect push rod adjustment. If both of these are satisfactory, disassemble the master cylinder and check for swollen or elongated primary piston seal(s). Also see Note 3.

c. Brake Leaks

1. With engine running at idle and transmission in Neutral, depress brake pedal and hold foot pressure on pedal. If pedal gradually falls away under foot pressure, hydraulic system is leaking.

(NOTE: Hydraulic system may be leaking internally as well as externally. See part b, Steps 1 and 2. Also system may appear to pass this test but still have slight leakage.)

d. Excessive Pedal Travel

1. On cars equipped with Tilt and Telescope steering column, place wheel in third position from top.

2. Hook end of tape over top edge of brake pedal pad, at approximately the center of the pad.

3. Unreel tape to rim of steering wheel, Fig. 5-5.

4. Place thumbnail at edge of wheel and take a reading of the extended length.

5. While holding tape, and with engine idling, press pedal with estimated 20-30 pounds force (the effort required for a moderate stop), and note reading on tape measure. The difference between the two readings is the amount of pedal travel.

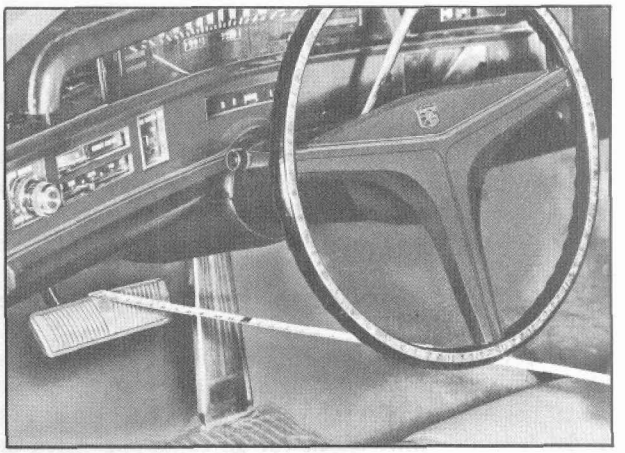


Fig. 5-5 Checking Brake Pedal Height

Pedal travel should not exceed 2-1/16 inch.

6. If pedal travel is greater than specification, first drive the car backward and forward to see if the brake pedal height will return to normal. In rare cases, excessive pedal travel develops if the car is not driven in reverse because the self-adjusting mechanism will actuate only in reverse when the brakes are applied.

Most low pedal problems are caused by air in lines, necessitating bleeding of the system. It may be necessary to bleed the system several times at each fitting. See Note 6.

Be sure to tap the calipers with a plastic headed hammer in the area of the piston to dislodge air bubbles while bleeding. If pedal travel exceeds specification, there may still be some air in the system.

Other less frequent causes of excessive pedal travel are rear brake shoe adjusters not functioning, shoes require relining, front or rear hydraulic system has lost its fluid, and tapered linings.

e. Road Testing Brakes

Brakes should be tested on dry, clean, smooth and reasonably level roadway which is not crowned. Road test brakes by making brake applications with both light and heavy pedal forces at various speeds to determine if car stops evenly and effectively.

Also drive car to see if it leads to one side or the other without brake application. If it does, check tire pressure, front end alignment and front suspension attachments for looseness. See diagnosis chart for other causes.

2. Testing Brake Tell-Tale Light Operation

1. Make sure wire is connected to brake combination valve.

2. Start engine, while ignition switch is in start position, brake tell-tale light should glow and go off when ignition switch returns to ignition position.

3. If system performs as described in step 2, and

pedal height is satisfactory (part d of Note 1), the system is all right.

4. If light fails to glow in start position, perform electrical tests outlined in Section 12, Note 28d.

5. If light does not go out with ignition switch in ignition position, disconnect wire from assembly. If light still does not go out, proceed as follows:

a. If car is equipped with Track Master, see Page 5-68.

b. If car is not equipped with Track Master, see Section 12, Note 28e.

If light goes out, this indicates that the terminal is shorted or there is a leak in the brake system. Check pedal height (part d of Note 1). If brake light glows and pedal height is low, check for all conditions listed in diagnosis chart on Page 5-7. If it is determined the terminal is shorted, replace the assembly.

(NOTE: The design of the brake combination valve is such that once a brake leak is sensed by the unit, a ground is made within the switch that will not be broken until the leak is corrected.)

3. Substandard or Contaminated Brake Fluid

Improper brake fluid, mineral oil, or water in the fluid may cause the brake fluid to boil or the rubber components in the hydraulic system to deteriorate.

When checking the fluid reservoir level, the level in the front reservoir may be as low as one inch from the top if the front linings are worn. This is not abnormal.

To check for deterioration of rubber parts, perform step 2 of Note 1b. If primary piston cups are swollen, then rubber parts have deteriorated. This deterioration may also be evidenced by swollen wheel cylinder piston cups on the drum brake wheels.

If deterioration of rubber is evident, disassemble all hydraulic parts and wash with alcohol. Dry these parts with compressed air before assembly to keep alcohol out of system. Replace all rubber parts in system including hoses. Also when working on the brake mechanisms, check for fluid on linings. If fluid is found, replace linings.

If master cylinder piston seals are all right, check for a leakage or excessive heat conditions. If condition is not found and still in doubt, drain fluid, flush with brake fluid, refill and bleed system.

4. Brake Hose Assembly

Each brake hose assembly should be inspected for obvious damage. An assembly should be replaced if a fitting has separated from the hose or if the hose is ruptured, damaged, worn, or blistered.

In the event of damage, the position of the assembly should be observed to determine if the installation was made properly. Check front brake hose by turning the wheel fully in both directions to determine if interference was the cause. Any interference could be the result of a wrong part or improper installation.

If the hose assembly is wet, the area should be dried. The brake system should be actuated and the assembly observed for leakage or presence of fluid. If fluid appears at the connection between the end fitting and the wheel cylinder or frame connection, the assembly should be removed and the hose fitting and the connection inspected for dirt or other foreign material. After cleaning by wiping or use of air hose, the part may be re-installed and the above check repeated. If fluid reappears, replace the part.

If fluid appears on the hose itself or at the junction of the hose and end fitting, the assembly should be replaced.

5. Parking Brake Preliminary Checks

It is not always necessary to replace the parking brake assembly or vacuum diaphragm assembly in cases of an inoperative parking brake automatic release. The following checks should be performed as part of your diagnosis to determine the cause and correction of parking brake trouble and to eliminate unnecessary replacement of parking brake components.

1. Check vacuum cylinder piston travel by running engine and moving transmission selector lever from Drive to Neutral. The manual release lever should move up and down as vacuum is applied and released. If no movement is observed, check vacuum system per steps 2 and 3. If movement is slow, (more than one or two seconds to complete the full stroke) diaphragm is leaking or hoses are partially pinched or kinked. Vacuum diaphragm may be replaced as outlined in Note 21.

2. Check for damaged or kinked vacuum hoses and for loose hose connections at parking brake vacuum cylinder, vacuum release valve at neutral switch, and at engine manifold connection.

3. Check adjustment of neutral switch and operation of vacuum release valve. Correct as necessary and recheck parking brake operation.

4. Check brake release with vacuum applied. If vacuum cylinder piston completes full stroke but does not release brake, a malfunction of the pedal assembly is indicated. Replace complete parking brake assembly as described in Note 20.

5. Check operation of parking brake with engine off. Parking brake should remain engaged regardless of transmission selector lever position. If not, replace parking brake assembly.

BRAKE DIAGNOSIS CHART

NOTE: Operation of Tell-Tale Brake Light may be checked as outlined in Note 28.

Symptom / CAUSE	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	Brakes Tell-Tale Glows
Leaking Brake Line or Connection	X	XX	X						X						XX
Leaking Wheel Cylinder or Piston Seal	X	XX	X	X				X							X
Leaking Master Cylinder	X	XX	X												X
Air in Brake System	XX		X						X						XX
Contaminated or Improper Brake Fluid	X				X	X	X								X
Leaking Vacuum System			XX		X										
Restricted Air Passage in Power Head		X	X		XX	X									
Damaged Power Head			X	X	X	X	XX								
Worn Out Brake Lining			X	X				X	X	X	X	X		X	
Uneven Brake Lining Wear - Replace	X			X				X	X	X	X	XX		X	X
Glazed Brake Lining - Sand			XX		X			X	X		X	X			
Incorrect Lining Material - Replace			X	X				X	X			X		X	
Contaminated Brake Lining - Replace				XX				XX	XX	X	X	X		X	
Linings Damaged by Abusive Use - Replace			X	XX				X	X	X	X	X		X	
Excessive Brake Lining Dust - Remove with Air			X	XX				XX	XX		X	XX		X	
Heat Spotted or Scored Brake Drums or Discs				X				X	X		X	X	XX	X	
Out-of-Round or Vibrating Brake Drums												X	XX		
Out-of-Parallel Brake Discs	X												XX		
Excessive Disc Run-Out	X												X		
Faulty Automatic Adjusters	X						X	X	X						X
Incorrect Wheel Cylinder Sizes			X	X				X	X						
Weak or Incorrect Brake Shoe Retention Springs				X		X	XX	X	X	XX	X	XX			
Brake Assembly Attachments - Missing or Loose	X						X	X	X	X		X	X	X	
Insufficient Brake Shoe Guide Lubricant							X	X	X	XX	XX				
Restricted Brake Fluid Passage or Sticking Wheel Cylinder Piston		X	X		X	X	X	X	X						X
Improperly adjusted Stoplight Switch or Cruise Control Vacuum Dump							X								
Faulty Metering Valve	X		X	X	X	X	X		X						X
Faulty Proportioning Valve			X	X	X	X	X		X						
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X								
Improperly Adjusted Master Cylinder Push Rod	X					X	XX								X
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X									X			X		
Loose Front Suspension Attachments							X	X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Incorrect Body Mount Torque													X		
Need to Slightly Increase or Decrease Pedal Effort														XX	
Operator Riding Brake Pedal			X				X		X					X	
Sticking Caliper or Wheel Cylinder Pistons							XX								

XX – Indicates more probable cause(s)
X – Indicates other causes

SERVICE INFORMATION

(NOTE: For service information pertaining to the Eldorado, refer to the latter portion of this section.)

BLEEDING AND ADJUSTMENTS

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology *"See CAUTION on Page 5-8 prior to Note 6."*

CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

6. Bleeding Brakes

Bleeding brakes may be made considerably easier through use of one of the pressure brake bleeder tools available. This equipment consists of a tank partially filled with brake fluid and rubber hose that connects to the hydraulic cylinder reservoir Brake Bleeder Adapter, J-22489-1. Air pressure is applied to the tank to force fluid into the brake system.

Pressure bleeding equipment must be of the diaphragm type. That is, kit must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaminates from entering the hydraulic system.

The Brake Bleeder Adapter, J-22489-1, seals the brake system from the atmosphere during the bleeding operation and enables the brakes to be bled with only one hook-up.

After bleeding brakes, check pedal travel as described in Note 1, part d. Rebleed or adjust brakes as necessary.

CAUTION: Always use heavy duty brake fluid, part number 546 4831 or its equivalent to SAE J-1703 specifications.

Do not spill brake fluid on car finish or damage will result.

a. Pressure Bleeder Method

1. Remove Master cylinder reservoir cover and seal assembly and fill both reservoirs with fluid.
2. Install Bleeder Adapter, J-22489-1 and cables J-22489-12, on master cylinder and connect bleeder hose to Bleeder Adapter Cover.
3. Install brake combination Valve Bleeder Retainer J-23770 so knob is held closed.
4. Build up pressure in bleeder. If car is not equipped with Track Master proceed to step 6.
5. Attach drain hose at bleeder fitting on modulator on Track Master cars. Back off fitting one-half turn and bleed brake fluid into a partially filled bottle of clean brake fluid until bubbles stop, then close fitting.
6. Raise car being careful not to damage pressure bleeder equipment.
7. Bleed right rear brake by attaching drain hose to bleeder fitting at wheel.
8. Back off fitting one half turn and bleed brake fluid into a partially filled bottle of clean brake fluid until bubbles stop, then close fitting.
9. Repeat steps 7 and 8 on left rear wheel.
10. Attach drain hose to bleeder fitting on right front caliper.
11. Back off fitting one half turn and bleed brake fluid into a partially filled bottle of clean brake fluid until bubbles stop, then close fitting. During the bleeding operation, tap the caliper lightly and repeatedly with a plastic-headed hammer.

(NOTE: Tapping the caliper is essential on disc brakes, as air bubbles tend to cling to the wall of the caliper.)

12. Repeat operation for left caliper.
13. After bleeding brakes, check pedal travel as described in Note 1, part d. Rebleed brakes if necessary.

(NOTE: As indicated in procedure, brakes are bled in the following order: modulator (Track Master cars) right rear, left rear, right front, left front.)

14. Lower car.
15. Remove Combination Valve Bleeder Retainer, J-23770.
16. Remove pressure bleeding equipment and check reservoir level. Level should be 1/8 inch to 3/8 inch from top.
17. Install master cylinder cover and seal assembly.
18. Before driving car, be sure a firm pedal is obtained.

b. Alternate Method

If a pressure bleeder is not available the following two man procedure may be used.

1. Fill both master cylinder reservoirs with brake fluid.

(NOTE: Keep reservoirs at least partially filled at all times during bleeding operation. More pedal pumping is required during this bleeding procedure than on cars with drum brakes at all wheels. The fluid level in the master cylinder reservoirs should therefore be frequently checked.)

2. Back off both master cylinder outlet pipe nuts one turn and completely depress brake pedal, catching fluid displaced from outlets in a cloth or can. Retighten

pipe nuts before releasing pressure on brake pedal. Repeat operation four times. Discard this fluid. Refill reservoirs.

(NOTE: If car is not equipped with Track Master, proceed to step 4.)

3. Attach drain hose at bleeder fitting on modulator on Track Master cars, apply pressure to brake pedal, back off fitting one half turn, and depress brake pedal. Close fitting before releasing pressure on brake pedal. Repeat pedal applications until bubbles stop.
4. Raise car.
5. Bleed right rear brake by attaching drain hose to bleeder fitting at wheel.
6. Apply pressure to brake pedal, back off fitting one-half turn, and depress brake pedal. Close bleeder fitting before releasing pressure on brake pedal. Repeat pedal applications until bubbles stop.
7. Repeat steps 4 and 5 on left rear wheel.
8. Attach drain hose to bleeder fitting on right front caliper.
9. Apply pressure to brake pedal, back off fitting one-half turn, and depress brake pedal. Close bleeder fitting before releasing pressure on brake pedal. Repeat applications until bubbles stop. During the bleeding operation, tap the caliper lightly and repeatedly with a plastic headed hammer.

(NOTE: Tapping the caliper is essential on disc brakes, as air bubbles tend to cling to the wall of the calipers.)

10. Repeat operation for left caliper.
11. After bleeding brakes, check pedal travel as described in Note 1, Part d. Rebleed brakes if necessary.

(NOTE: As indicated in procedure, brakes are bled in the following order: Modulator (Track Master cars), right rear, left rear, right front, left front. Do not rebleed rear brakes unless necessary. Any air left in system will generally be in front brake system, in which case bleed right front and then left front brakes.)

12. Lower car.
13. Check reservoir level. Level should be 1/8 inch to 3/8 inches from top.
14. Install master cylinder cover and seal assembly.
15. Before driving car, be sure a firm pedal is obtained.

7. Rear Drum Brake Shoe Adjustment

Although the hydraulic service brakes are self-adjusting, a preliminary star wheel adjustment is necessary after the rear brake shoes have been relined or replaced, or when the length of the star wheel adjuster has been changed during some other service operation. Final adjustment is made automatically by adjusters that function when the car is moving backward. No mechanical adjustment is required when replacing front disc brake shoe and lining assemblies.

1. Raise car and remove rear wheels and drums if not already removed.
2. Check to make certain that parking brake cable and linkage, including levers on rear secondary shoes, are free.
3. Measure brake drum I.D. using inside caliper portion of tool J-21177, Fig. 5-6.
4. Adjust brake shoes to dimension obtained on outside caliper portion of tool J-21177, Fig. 5-7.
5. Check brake fluid level in both master cylinder reservoirs. Fluid level should be approximately 1/8 to 3/8 inches below top of reservoir. Add fluid if necessary.
6. Adjust parking brake as described in Note 8.
7. Install drums and wheels. Lower car.
8. Drive car alternately forward and backward, applying brakes moderately in each direction until pedal travel does not exceed specifications listed in Note 1, part d.

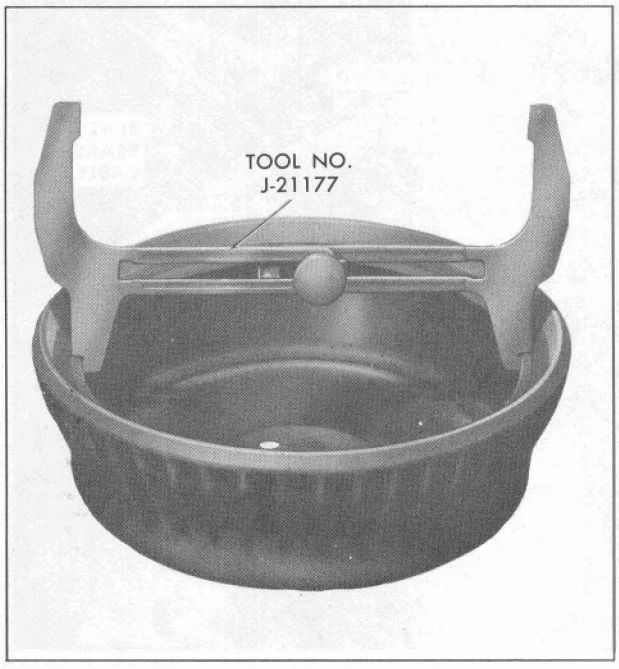


Fig. 5-6 Inside Drum Measurement

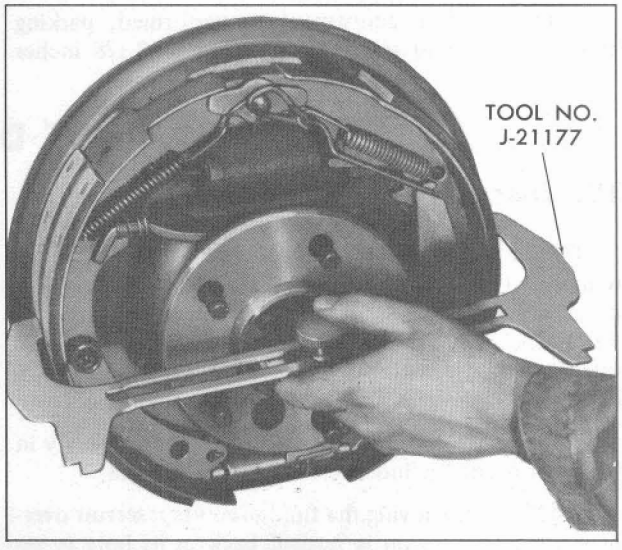


Fig. 5-7 Adjusting Brake Shoes

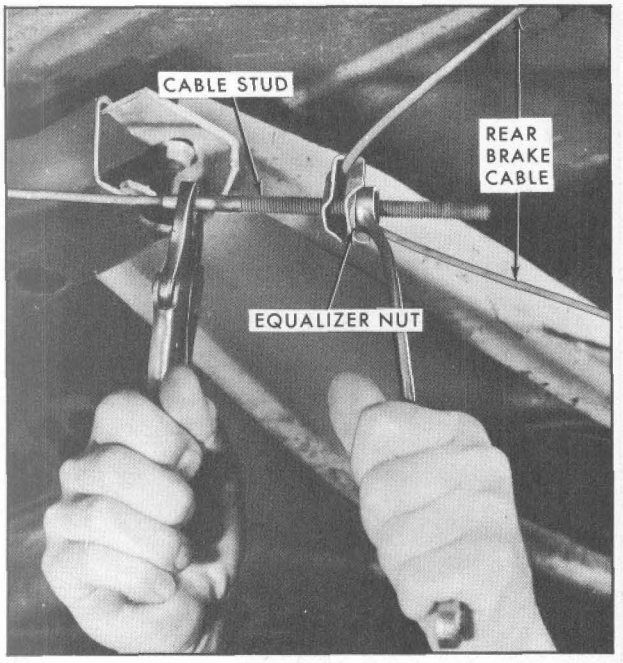


Fig. 5-8 Parking Brake Adjustment

8. Parking Brake Adjustment

(NOTE: Make sure that rear drum brakes are properly adjusted before adjusting parking brake.)

1. Lubricate parking brake linkage at equalizer and cable stud, and check for free movement of all cables.
2. Depress parking brake pedal approximately 1¾ inches from fully released position, measuring with a ruler.
3. Raise rear wheels off floor.
4. Hold brake cable stud from turning, and tighten equalizer nut, Fig. 5-8, until light drag is felt on either wheel (going forward). After each turn of equalizer nut, check to see if either wheel begins to drag.
5. Release parking brake. No brake shoe drag should be felt at either rear wheel. Operate several times to check adjustment.

(NOTE: After adjustment is performed, parking brake pedal should travel 1-1/8 inches to 2-1/8 inches

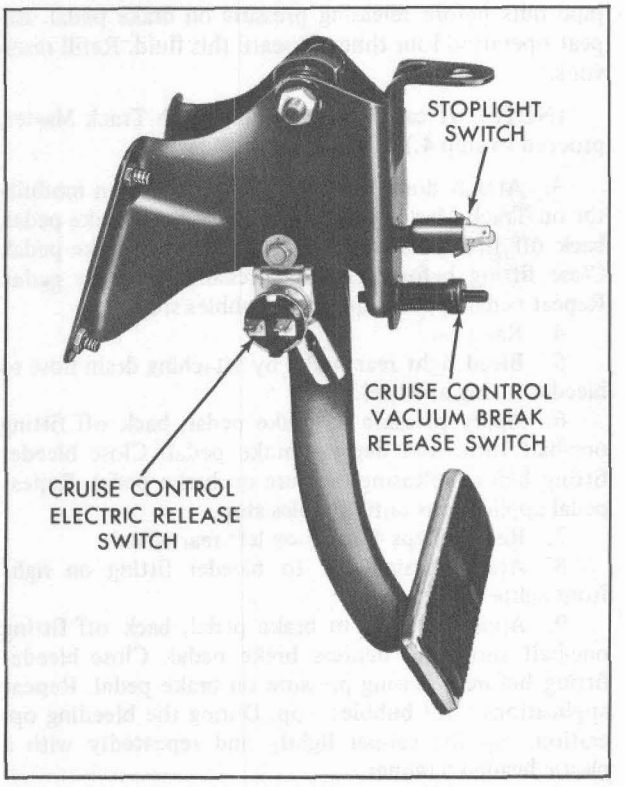


Fig. 5-9 Stoplight Switch Location

with approximately 50 pounds force on pedal.)

6. Lower rear wheels.

9. Stoplight Switch Adjustment

The brake stoplight switch and Cruise Control switch are adjusted in an identical manner. Push the switch well into the retaining clip. Pulling the brake pedal fully up to its stop will automatically adjust the switch, Fig. 5-9.

Rotate switch 1/2 turn counterclockwise to be sure that stoplight switch or Cruise Control switch does not hold brake pedal on after adjustment. There should be free play between brake pedal and bracket when pedal is pulled toward released direction from unapplied position.

FRONT DISC BRAKES

10. Disc Brake Relining (All)

(NOTE: Check lining on brakes any time wheels are removed. (Tire rotation, etc.). Inboard lining may be checked by looking through inspection hole in caliper. When thickness of any lining is about the same as the thickness of the metal shoe, all shoe and lining assemblies should be replaced.)

1. Remove two thirds of the total fluid capacity in the front master cylinder reservoir. Discard fluid.

(NOTE: Removing the fluid prevents reservoir overflow when the piston is pushed back in its bore to remove the caliper.)

2. Raise car and remove front wheels.
3. Position 7 inch "C" clamp on the caliper so that solid side rests against back of caliper assembly. The screw end rests against back of outboard shoe, Fig. 5-10.
4. Tighten "C" clamp until caliper moves out far enough to push piston to bottom of piston bore. This will release the pressure on shoe and lining assemblies.
5. Remove "C" clamp.
6. Remove two bolts that hold caliper to steering knuckle, Fig. 5-11.

(NOTE: It is not necessary to remove brake hose when relining disc brakes.)

7. If working on Eldorado, it will be necessary to remove cotter pin, loosen upper ball joint nut and slip

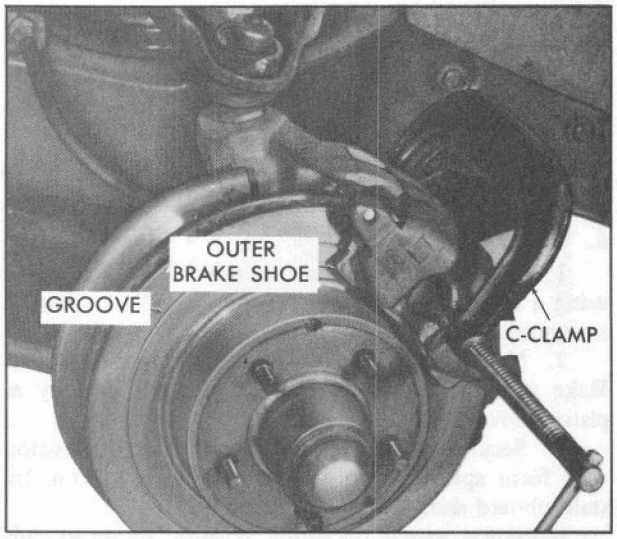


Fig. 5-10 Pushing Piston into Bore

brake hose collar out of its clip. The slack gained will permit removal of caliper without pulling hose.

8. Slide caliper off disc and support with a hook-shaped wire fastened to upper control arm.

CAUTION: Do not allow caliper to hang from brake hose.

9. Remove inboard shoe and spring from piston.
10. Remove outboard shoe from caliper.
11. Push out two sleeves from inboard ears of the caliper.
12. Remove four rubber bushings, two on inboard ears and two on outboard ears.
13. Examine piston area for fluid leaks by looking for excessive moisture around boot area. Check dust boot for cuts, cracks or other damage which would affect its ability to seal piston bore. If leaks are present or boot shows damage, caliper should be overhauled as described in Note 13. If no defects are found, wipe clean the inside of the caliper including four ears where bushings are installed. Wipe the outside surface of the dust boot clear of all dirt so that when piston is pressed to bottom of bore, boot will fold back without coming out of groove in piston.

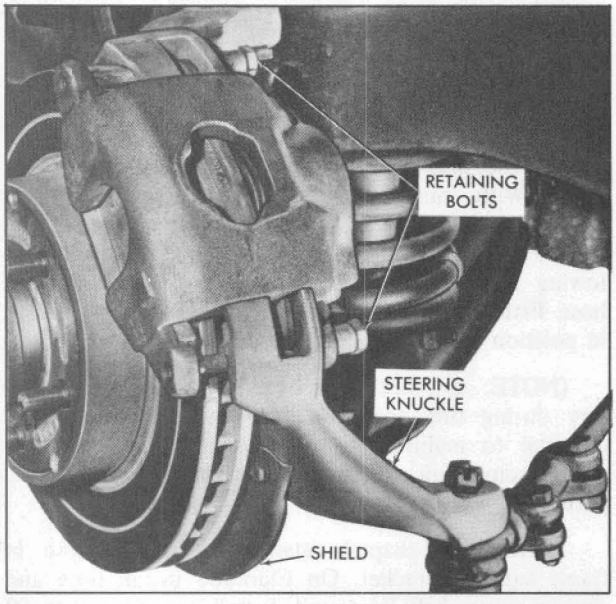


Fig. 5-11 Sliding Caliper Disc Brake

CAUTION: Do not use air for cleaning caliper because of the possibility of unseating dust boot.

14. Examine both sides of disc for scoring or rough finish. Refer to Note 15 to determine condition of disc. In normal use, a slight ridge of rust may form on the edge of the disc. This ridge may be removed with sandpaper.
15. Make sure the piston is bottomed in the piston bore. Make sure the dust boot has folded back correctly as the piston moved back.
16. Wipe out grooves in caliper ears and install new bushings.
17. Lubricate new sleeves on outer surface with silicone lubricant. Push in two sleeves and position the sleeve so that end toward the shoe and lining assembly is flush with the machined surface or the ear.
18. Secure clip-on spring to inner shoe or position wire form spring inside cut-out section of piston. Install inboard shoe and lining assembly.

If using a wire form spring, position spring so ends contact shoe centrally while touching piston. Shoe will fit at an angle with top edge away from piston. Press down on ears at top of shoe until shoe is seated. When spring is properly positioned, ends will extend no more than .100 inch (approx. 3/32") beyond shoe.

19. Place the outboard shoe and lining in the caliper so that the lining faces toward the disc. The two ears at the ends of the shoe fit over the ears on the caliper. The flange on the bottom of the shoe fits into the cut-out section of the caliper.
20. Crimp outboard shoe ears so that they fit snugly on caliper.
21. Position caliper on disc and line up holes in caliper ears with holes in steering knuckle. Make sure the brake hose is not twisted as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.
22. Wipe all dirt and corrosion from the caliper mounting bolts. Do not use abrasives, as they will remove protective plating. Lubricate smaller ends of bolts with silicone lubricant.
23. Start either bolt into the inboard ear of the caliper and into the steering knuckle. At this point it is necessary to be sure that the bolt passes under the retaining ear on the inboard shoe to maintain the shoe in position in the caliper, Fig. 5-11.
24. Pass the bolt on through the outboard ear on the caliper until the threads on the bolt can be started into the steering knuckle.
25. Repeat steps 23 and 24 in placing remaining bolt into caliper assembly.
26. Tighten caliper mounting bolts to 25 to 35 foot-pounds. (For steps 26, 27, 28, *see CAUTION page 5-8, prior to Note 6.)*
27. If working on an Eldorado, center brake hose collar in clip and tighten upper ball joint nut to 60 foot-pounds. Install cotter pin.

28. Repeat steps 3 through 27 on other brake assembly. Always reline both front brakes.

29. Install wheels, tighten wheel mounting nuts to 105 foot-pounds, and lower car.

30. Before moving the vehicle, pump the brake pedal two or three times to insure firm pedal.

31. Allow car weight to be supported on front wheels and inspect front brake hoses for twisted condition. If necessary, correct as described in Note 24 a and b or 34 a and b.

32. Check the master cylinder reservoirs and fill to 1/8 to 3/8 inch from top.

33. Any time the front brakes are relined, the rear drum brakes should be checked.

34. Break in new linings as described in Note 11.

11. Break-In of New Linings (All)

New or replacement brake linings, if subjected to normal usage at speeds under 50 MPH need no special break-in. However, the first few brake applications may be somewhat erratic, and it may be necessary to stabilize the brakes before delivering the car to the owner. If brake action is erratic, one acceptable way to seat the brakes is to make five or ten moderate brake stops at speeds of 30 to 40 MPH, at approximately one-half mile intervals.

12. Disc Brake Caliper Assembly (All)

a. Removal

1. Remove two thirds of the total fluid capacity in the front master cylinder reservoir. Discard fluid.

(NOTE: Removing fluid prevents reservoir overflow when the piston is pushed back in its bore to remove the caliper.)

2. Raise car and remove wheels.

3. Position a "C" clamp on the caliper so that solid side rests against back of caliper assembly. The screw end rests against back of outboard shoe, Fig. 5-10.

4. Tighten "C" clamp until caliper moves out far enough to push piston to bottom of piston bore. This will release the pressure on shoe and lining assemblies.

5. Remove "C" clamp.

6. Disconnect steel brake line from hose and cap fittings to prevent dirt from entering brake line or hose.

7. Remove U-shaped retainer from hose fitting and withdraw hose from frame support bracket. On Eldorado remove upper ball joint cotter pin and nut. Slide hose clip off ball joint stud. On right side of Eldorado remove clip located at frame side bar.

8. Remove two bolts which hold caliper to steering knuckle.

9. Slide caliper off disc.

10. Remove inboard shoe from caliper.

11. Outboard shoe may have disengaged itself from caliper as caliper was removed from disc. If it did not disengage itself, remove outboard shoe.

12. Place caliper on clean workbench and remove hose and copper washer from caliper inlet fitting. Discard washer.

13. Overhaul caliper as described in Note 13.

b. Inspection of Disc

1. With caliper assembly off disc, inspect disc as described in Note 15.

c. Installation

1. Connect brake hose to inlet hole on caliper using a new copper washer. Tighten to 30 foot-pounds maximum torque.

2. Make sure piston is bottomed in piston bore. Make sure the dust boot has folded back correctly as piston moved back.

3. Secure clip-on spring to inner shoe or position wire form spring inside cut-out section of piston. Install inboard shoe and lining assembly.

If using a wire form spring, position spring so ends contact shoe centrally while touching piston. Shoe will fit at an angle with top edge away from piston. Press down on ears at top of shoe until shoe is seated. When spring is properly positioned, ends will extend no more than .100 inch (approx. 3/32") beyond shoe.

4. Place outboard shoe and lining in caliper so that lining faces toward disc. The two ears at ends of shoe fit over ears of caliper. Flange on bottom of shoe fits into cut-out section of caliper. Crimp outboard shoe ears down over flange of caliper.

5. Position caliper on disc and line up holes in caliper ears with holes in steering knuckle.

6. Lubricate smaller ends of caliper bolts with silicone lubricant.

7. Start either bolt into inboard ear of caliper and into steering knuckle. At this point it is necessary to be sure that bolt passes under retaining ear on inboard shoe to maintain shoe in position in caliper, Fig. 5-11.

8. Pass bolt on through outboard ear on caliper until threads on bolt can be started into steering knuckle.

9. Repeat steps 7 and 8 in placing remaining bolt into caliper assembly.

10. Tighten caliper mounting bolts to 25 to 35 foot-pounds.

11. Install wheel and tighten mounting nuts to 105 foot-pounds torque. (For steps 10 and 11 *see CAUTION on page 5-8, prior to Note 6.)*

12. With suspension in normal position (front wheel straight and vehicle weight on front wheels) pass female end of hose through frame support bracket, allowing hose to seek its own position. Insert hex of hose fitting into the 12-point hole in support bracket in position that will result in least twist in hose.

(NOTE: Do not twist hose any more than necessary during this operation as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.)

13. Install U-shaped retainer to secure hose in frame support bracket. On Eldorado install hose and clip on upper ball joint stud. Install nut. Torque to 60 foot-pounds and insert cotter pin.

14. Inspect by turning steering from stop-to-stop while observing hose position. Be sure that hose does not touch other parts at any time during steering travel. If contact does occur, remove hose retainer and rotate female hose end in support bracket one or two points in appropriate direction, replace retainer, and re-inspect.

15. Place steel tube connector nut in hose fitting and tighten to 20 foot-pounds maximum torque.

16. Bleed all brakes as outlined in Note 6.

17. Before moving car, pump brake pedal two or three times to insure a firm pedal.

13. Disc Brake Caliper Disassembly, Cleaning, Inspection and Assembly (All)

a. Disassembly

1. Remove caliper assembly as described in Note 12a.

2. Clean the caliper exterior with denatured alcohol.

3. Push out two sleeves from inboard ears of the caliper.

4. Remove four rubber bushings, two on inboard ears and two on outboard ears.

5. Place a pad of clean shop towels on caliper bridge, Fig. 5-12.

(NOTE: The towels will prevent damaging the piston when it is pushed out by air pressure.)

6. Use service air hose to apply moderate air pressure to brake fluid inlet hole to force piston out of caliper. Keep fingers clear of piston.

CAUTION: Use clean air only. Air supplies that are lubed or oiled contain mineral oil that will damage rubber parts.

7. Using a screwdriver, pry boot out of housing, being careful not to scratch bore, Fig. 5-13. Discard boot.

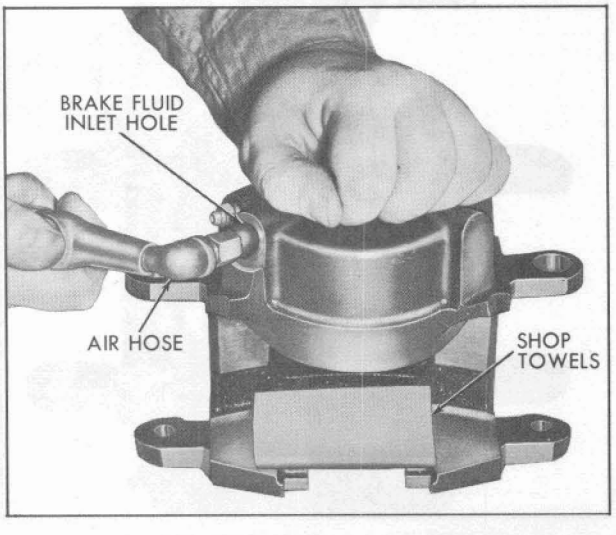


Fig. 5-12 Removing Piston

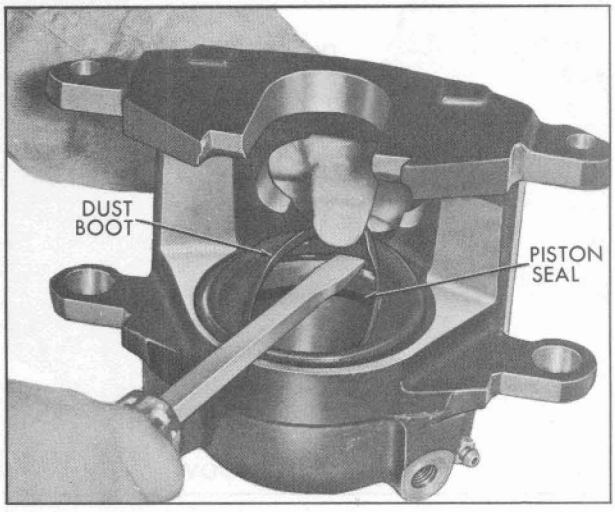


Fig. 5-13 Removing Dust Boot

8. Using a plastic toothpick, remove piston seal from groove in bore and discard seal.

CAUTION: Do not use any metallic device to remove the seal, as it may scratch or damage the bore or groove.

9. Remove bleeder fitting from caliper assembly.

b. Cleaning and Inspection

1. Inspect the caliper brake hose for worn spots, cracks or other signs of deterioration. Replace if necessary.

2. Inspect the piston for scoring, pitting, nicks, corrosion and worn or damaged chrome plating. If any of these faults appear, it will be necessary to replace the piston.

3. The bore should be inspected for the same defects as the piston with the exception of chrome plate. Stains or corrosion can be polished with fine crocus cloth. Wash caliper bore with clean denatured alcohol. If the defects cannot be cleaned up in this manner, it will be necessary to replace the caliper.

4. All passageways should be blown out with clean air.

5. Clean the caliper mounting bolts and caliper ear grooves of all dirt and corrosion. Do not use abrasives on bolts, as they will remove protective plating.

c. Assembly

1. Install bleeder fitting in caliper.

2. Lubricate piston bore and new piston seal with brake fluid.

3. Position the new seal in the groove in the piston bore.

4. Assemble new dust boot on piston, so that inner diameter of boot is secured in groove and boot fold faces away from closed end of piston, Fig. 5-14.

(NOTE: Do not use previously removed boot.)

5. Lubricate sealing surface of piston with brake fluid. Position piston in bore and press it down to bottom of bore. Make certain dust boot does not disengage from groove in piston.

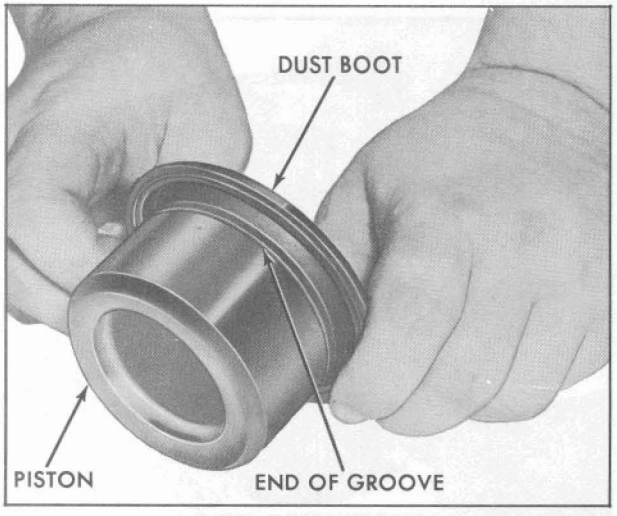


Fig. 5-14 Assembling Dust Boot on Piston

6. With dust boot evenly positioned in caliper counterbore, position Boot Installer, J-22904, on boot and tap with a plastic hammer to seat boot, Fig. 5-15.

7. Lubricate four new bushings with silicone lubricant and install bushings in caliper ears.

8. Lubricate new sleeves with silicone lubricant and install in inboard caliper ear. Position the sleeve so that end toward the shoe and lining assembly is flush with the machined surface of the ear.

9. Install caliper assembly as described in Note 12c.

14. Hub and Disc Assembly

The procedure for removing and installing the "C" car hub and disc assembly is described in Section 3, Note 16.

15. Servicing Discs

When performing any service on front disc brakes, inspect the disc ventilation passages for obstructions, such as salt or mud build-up. Any build-up must be removed because it decreases brake cooling, which might lead to increased lining wear rate and brake shudder.

When new linings are installed, the disc should be lightly sanded using a circular non-directional motion. A slight ridge of rust may form on the edge of the disc, during normal use. This ridge should be removed during the sanding operation.

Scoring of the disc brake rotor, due to advanced wear of linings, does not always necessitate replacement of the disc. Discs with scoring of the surface up to approximately .020 inch in depth are not detrimental to brake operation and may be used with new linings.

Once a wear pattern has been established, front disc brake cars are not as susceptible to problems occurring because of scored discs as front drum brake cars are due to scored drums.

In normal servicing of worn lining or on caliper removal, lateral runout of the disc need not be checked, except when brake shudder is evident.

If brake shudder develops after long periods of use, it may be caused by light surface deposits (such as lining oxides) on the braking surface of the disc. These deposits, which appear as a dark blotch about the size of half-dollars, may be removed by sanding.

Brake shudder on low mileage cars may be caused by excessive disc lateral runout or out-of-parallelism.

Before checking runout and parallelism, check disc thickness. If total disc thickness is less than 1.215 inch on all except the Eldorado or 1.190 inch on the Eldorado, the disc must be replaced. Some discs may already be at minimum thickness, so the disc must be checked before attempting a refinishing operation.

When checking runout of the "C" car, first tighten front wheel bearing to take up end play. If "C" car lateral runout is in excess of .005 inch, or parallelism is in excess of .0007 inch, the disc should be refinished or replaced.

On the Eldorado, lateral runout of the hub and disc assembly must not exceed .008 inch or parallelism .0005 inch. If these specifications are exceeded, the disc should be refinished or replaced. When checking runout on this car, the wheel nuts must be installed with the flat portion of the hex against the disc to retain the disc against the hub.

The 1972 hub and disc assembly (except 693, 697, 698) is a cast integral unit and is not interchangeable with the 697 and 698 Series hub and disc. Both are machined as a unit and must be replaced as an assembly in the field. In contrast, the Eldorado hub and disc are replaceable separately. On all cars it is not necessary to replace both front discs when only one is defective. Replace only defective discs.

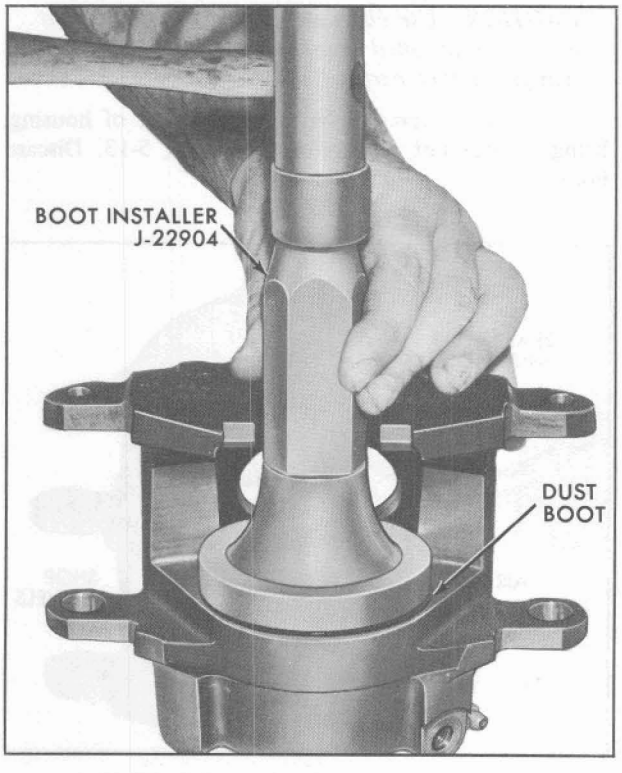


Fig. 5-15 Installing Dust Boot in Caliper

Since extremely accurate control of the finishing operation is necessary for proper performance, refinishing of the rubbing surface is not recommended unless precision equipment is available and surfaces can be held within specifications listed.

REAR DRUM BRAKES

16. Rear Drum Brake Shoe Assemblies

When brake relining is necessary, it is recommended that the complete brake lining and shoe assemblies be replaced with new assemblies. New lining and shoe assemblies are precision-ground to fit the drum diameter, minimizing the possibility of imperfect braking action due to warped brake shoes or partial contact between linings and drum.

Those Service Departments that have adequate brake shoe relining equipment may obtain linings, drilled and cut to size, from their servicing Parts Distribution Center. Brake lining grinding equipment should incorporate brake shoe holders that locate the shoes accurately in relation to the anchor end, as brake anchors are not adjustable and require accurately ground linings.

17. Relining Rear Drum Brakes (All Except 693) (Fig. 5-16)

1. Release parking brake, raise car, and remove rear wheels.
2. Remove rear brake drum assemblies.
3. Loosen parking brake cable locknut on equalizer.
4. Remove primary brake shoe retracting spring, using Brake Spring Remover and Installer, J-8049.
5. Disconnect link at anchor and remove link, secondary brake shoe retracting spring, and anchor plate.
6. Remove primary brake shoe hold-down cup, spring and pin, and secondary brake shoe hold-down pin, cup, spring, and sleeve.
7. Remove pawl return spring, actuating lever, and pawl.
8. Disengage brake shoes from wheel cylinder connecting links and parking brake strut rod. Remove strut rod and spring.
9. Disconnect parking brake cable from operating lever on secondary shoe and remove complete shoe and lining assembly from brake backing plate.
10. Remove star wheel adjuster and primary to secondary connecting spring from shoe assembly.
11. Remove clip from pin on secondary brake shoe and remove operating lever and pin assembly.
12. Clean brake backing plate and all brake parts.

CAUTION: Make certain that hands are clean when handling brake parts and avoid handling friction surfaces of drums and linings.

13. Tighten nuts that hold backing plate to rear axle housing to 40 foot-pounds maximum torque.
(See CAUTION page 5-8 prior to Note 6.)
14. Install operating lever and pin assembly on replacement secondary brake shoe and secure with clip.
15. Lubricate threads and socket of star wheel adjuster and points of contact between brake and other brake parts with a heat resistant lubricant, part number 545 0032 or its equivalent. Use sparingly, especially on brake shoe pads.
16. Thread star wheel adjusting screw completely into pivot nut to permit installation of brake drum over replacement brake shoes.
17. Install star wheel adjuster and primary-to-secondary connecting spring on brake shoes. Make certain that star wheel rotates in proper direction.

(NOTE: Maroon springs are used on both left and right hand rear brake shoe assemblies. These springs are interchangeable.)

Star wheel adjusters with three wide grooves on O.D. of pivot nut (left hand threads) Fig. 5-17, are installed on right side of car and those with three narrow

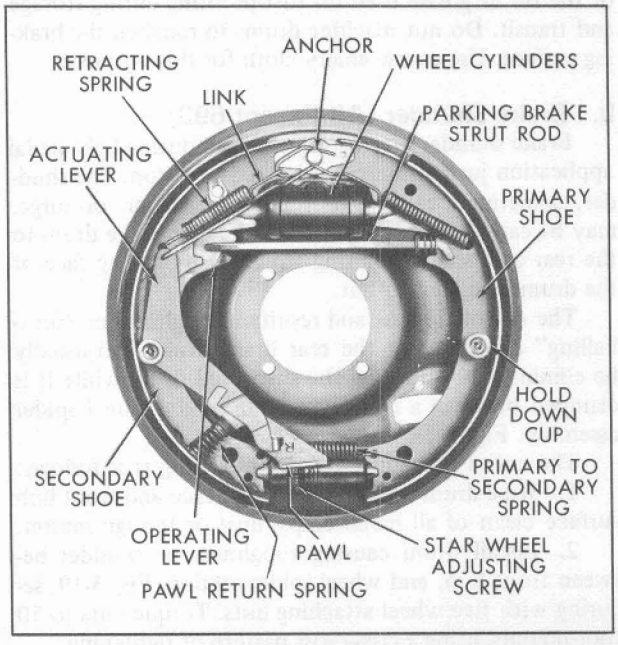


Fig. 5-16 Rear Wheel Drum Brake Mechanism

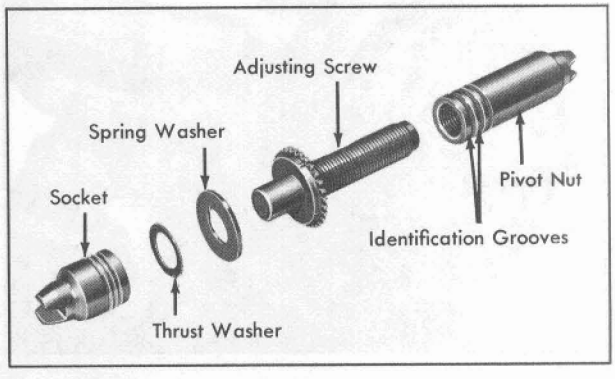


Fig. 5-17 Star Wheel Adjuster Disassembled

grooves on O.D. of pivot nut (right hand threads) must be installed on left side.

18. Position shoe assembly on brake backing plate and connect parking brake cable to operating lever.

19. Install parking brake strut rod and spring on brake shoe assembly.

(NOTE: Light blue spring is used on left side and white spring on right side. These springs are not interchangeable. Spring tab must be positioned outside of brake shoe web on both rear brakes.)

20. Engage shoes with wheel cylinder connecting links and install hold-down pin, cups, and spring on primary brake shoe.

(NOTE: Maroon primary and blue secondary hold-down springs are used on the rear brake assemblies.)

21. Position actuating lever and pawl so that actuating lever is on top of secondary brake shoe. Secure with hold-down pin, sleeve, spring, and cup.

22. Install anchor plate, link, and secondary brake shoe retracting spring (yellow). For easiest installation, first connect spring to link then install link on anchor, using brake Spring Remover and Installer, J-8049.

23. Install pawl return spring. Make certain that star wheel engages pawl.

24. Install primary brake shoe retracting spring (red) using Spring Installer, J-8049.

25. Install rear brake drums on rear axle shaft flange and secure with screw.

26. Perform preliminary service brake adjustment as described in Note 7.

27. Install wheels on brake drums. Tighten wheel mounting nuts to 105 foot-pounds.

(See CAUTION page 5-8 prior to Note 6.)

28. Adjust parking brake as described in Note 8.

18. Machining Brake Drums

a. Warped or Scored

Brake drums should be carefully checked to see if they have become warped or scored excessively. If they appear salvageable and if suitable equipment is available,

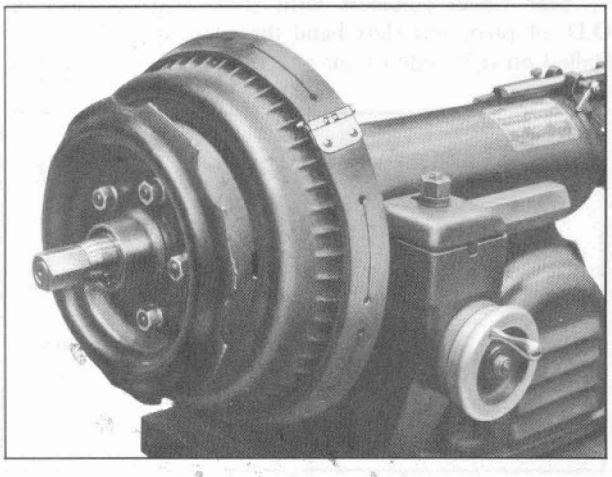


Fig. 5-18 Assembly Mounted on Lathe

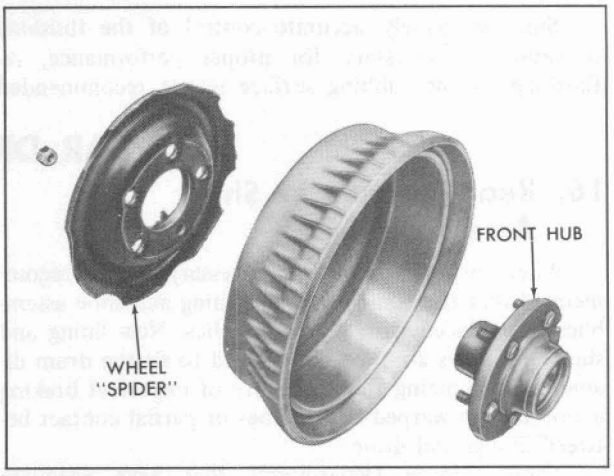


Fig. 5-19 Assembling Spider & Hub to Drum

they can be machined.

Drum machining is a precision operation. Equipment used for this purpose must be capable of maintaining the close limits specified. Be sure to install drum in the machining equipment correctly and to check runout of lathe spindle to insure accuracy of final machining operation. Inside drum diameter must not be machined over 12.060 inches on all cars except the Eldorado or 11.060 inches on the Eldorado. Should brake drums be machined too thin, the intense heat that develops under severe driving conditions will cause them to distort, crack or warp.

In addition, the specifications listed on page 5-31 for all cars except the Eldorado or page 5-40 for the Eldorado must be held.

Replacement brake drums supplied by your servicing Parts Warehouses are machine-finished at the factory before being shipped. They do not require any further finishing before installation, but they must be thoroughly cleaned with a non-oil base solvent to remove all traces of the oil or grease used for rust-proofing during storage and transit. Do not machine drums to roughen the braking surface. Use coarse emery cloth for this purpose.

b. Brake Shudder (All Except 693)

Brake shudder may be experienced during light pedal application just as the car is braked to a stop. The shudder, sometimes called "footballing", chatter, or surge, may be caused by improper fit of the rear brake drum to the rear axle shaft, resulting from the mounting face of the drum being out-of-flat.

The out-of-flatness and resultant roughness or "footballing" condition of the rear brake drums can usually be eliminated by turning the suspected drum while it is clamped between a front wheel hub and a wheel spider assembly. Fig. 5-18

The entire procedure for drum-turning is as follows:

1. Wipe drum inner mounting surface and front hub surface clean of all metal chips, dust or foreign matter.

2. Install drum causing roughness or shudder between front hub, and wheel spider section, Fig. 5-19, securing with five wheel attaching nuts. Torque nuts to 50 foot-pounds, using a criss-cross pattern of tightening.

3. Turn drum on a lathe in usual manner that a

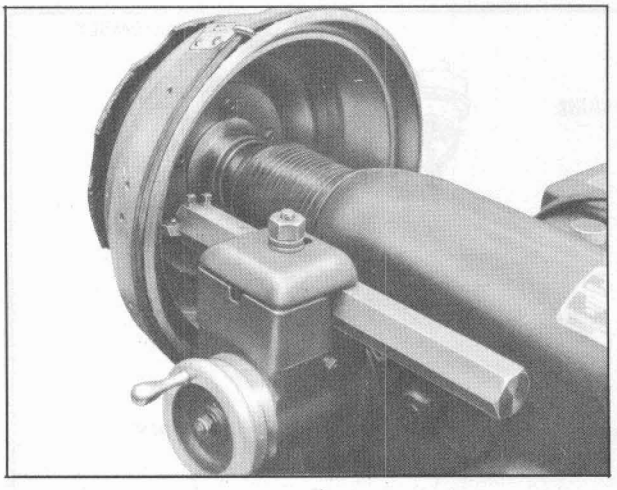


Fig. 5-20 Turning Drum

front drum would be turned, Fig. 5-20.

4. After turning drum, unbolt assembly and remove drum. Drum is now ready for installation on car and roadtesting to confirm correction of brake roughness or shudder.

This procedure can be used for all Cadillac rear drums that exhibit brake shudder, and all past model front drums regardless of the make of drum.

(NOTE: Front drums of past models have the hub assembled so only the wheel spider need be mounted on these drums before turning.)

Though the front wheel, tire, hub and drum of past models can be removed from the car as an assembly and turned as an assembly on some lathes, it is recommended the tire and wheel assembly be removed from the drum, and the wheel spider be installed before turning. This permits greater ease of handling and places less weight on the drum lathe spindle bearings.

19. Wheel Cylinder Servicing

a. Removal

1. Raise car and remove wheel and brake drum. Blow out dust and dirt from drum and linings.

2. Disconnect hydraulic brake piping from wheel cylinder.

3. Remove brake shoe retracting springs and link.

4. Remove two screws holding wheel cylinder to backing plate.

5. Disengage wheel cylinder connecting links from brake shoes and remove wheel cylinder.

CAUTION: Be sure brake fluid does not drip on brake linings.

b. Disassembly (Fig. 5-21)

1. Remove connecting links and rubber boots from ends of wheel cylinder.

2. Slide pistons and piston cups from either end of cylinder.

3. Remove piston cups, spring and expander assembly.

4. Remove bleeder screw assembly.

c. Cleaning and Parts Replacement

With clean hands, wash all parts except pistons in clean alcohol. Wipe pistons with clean dry cloth. Inspect surface of cylinder bore and hydraulic passages. Replace wheel cylinder if any obstructions are observed in holes or if there are any nicks or burrs in bore.

If it is necessary to replace any of the wheel cylinder assembly parts, refer to parts book for replacement parts.

d. Assembly (Fig. 5-21)

1. Install bleeder screw assembly.

2. Install piston cup in one end of cylinder with lip toward center, and install piston with flat side toward cup.

3. Install rubber boot into end of wheel cylinder.

4. Install spring and expander assembly.

5. Install other piston cup, lip toward center. Install piston, flat side toward cup.

6. Install remaining rubber boot into end of cylinder.

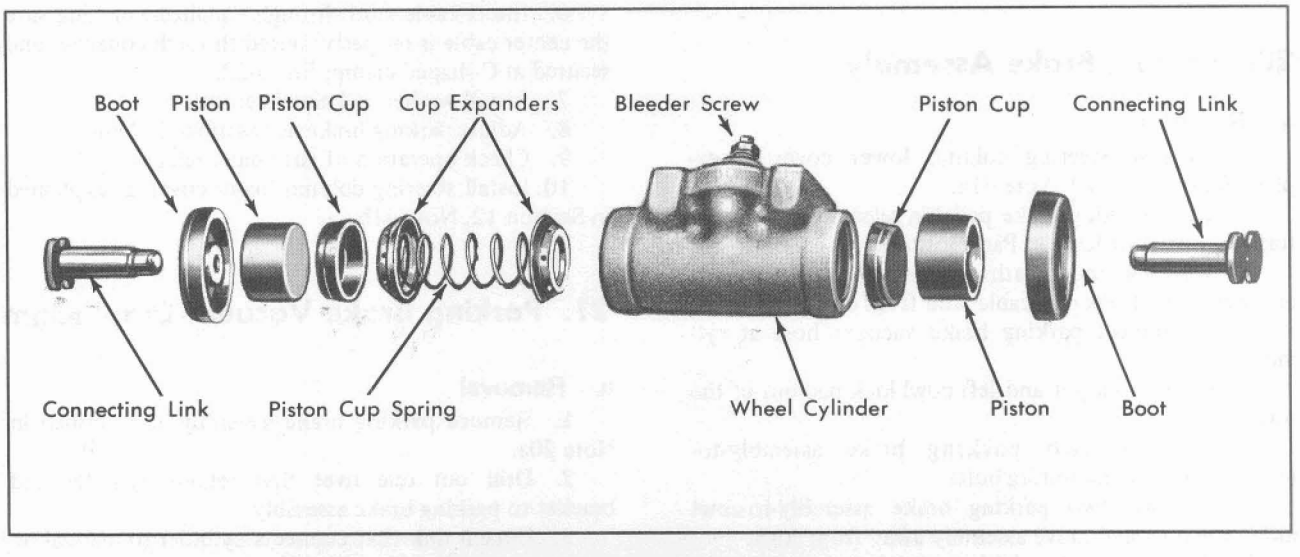


Fig. 5-21 Wheel Cylinder Disassembled

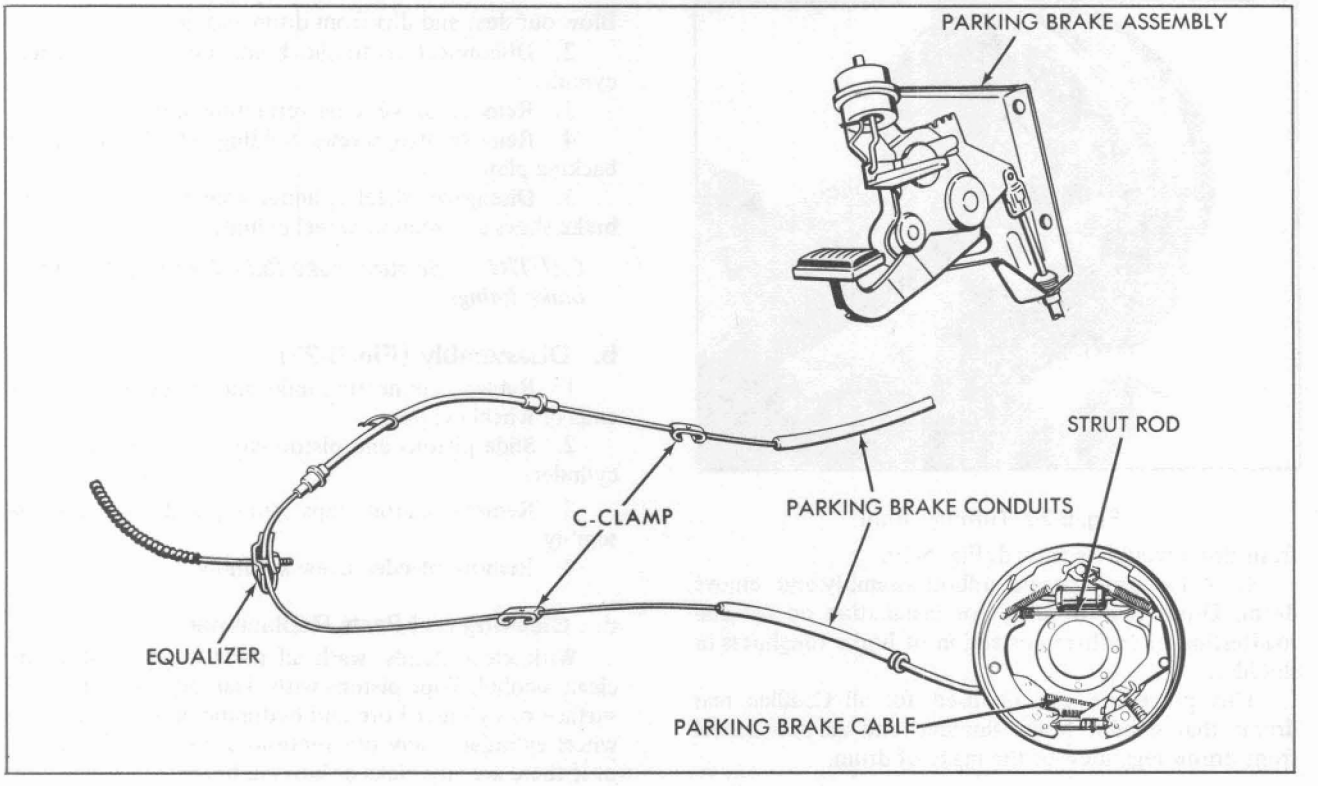


Fig. 5-22 Parking Brake Linkage

e. Installation

1. Position wheel cylinder on brake backing plate, slipping cylinder-to-shoe connecting links in place at same time.
2. Install two screws holding wheel cylinder to backing plate. Tighten to 15 foot-pounds maximum torque.
3. Install brake shoe retracting springs and link.

(NOTE: Avoid handling friction surfaces of drums and linings.)

4. Connect brake piping to wheel cylinders.
5. Install brake drum and wheel assembly.
6. Bleed all brakes as described in Note 6.

20. Parking Brake Assembly

a. Removal

1. Remove steering column lower cover as explained in Section 12, Note 41a.
2. Place parking brake pedal in release position. Set transmission shift lever in Park position.
3. Working underneath car, remove equalizer nut and washer and separate cable stud from equalizer.
4. Disconnect parking brake vacuum hose at cylinder.
5. Position carpet and left cowl kick-pad out of the way.
6. Remove two parking brake assembly-to-instrument panel mounting bolts.
7. Remove two parking brake assembly-to-cowl mounting nuts and move assembly away from cowl.
8. Position brake pedal lever so that clevis on parking brake assembly is exposed, and remove brake cable end from clevis.

b. Installation

1. Position parking brake pedal so that clevis is exposed, and attach parking brake cable to clevis on parking brake assembly.
2. Place parking brake assembly on studs on cowl, attaching with two mounting nuts.
3. Install two parking brake assembly-to-instrument panel mounting bolts.
4. Connect hose to parking brake vacuum cylinder.
5. Replace cowl kick-pad and carpet.
6. Insert cable stud through equalizer, making sure the center cable is properly routed through equalizer and secured at C-shaped clamp, Fig. 5-22.
7. Install washer and equalizer nut.
8. Adjust parking brake as described in Note 8.
9. Check operation of automatic release.
10. Install steering column lower cover, as explained in Section 12, Note 41b.

21. Parking Brake Vacuum Diaphragm

a. Removal

1. Remove parking brake assembly as described in Note 20a.
2. Drill out one rivet that retains cylinder and bracket to parking brake assembly.
3. Detach link that connects cylinder to manual release lever and remove cylinder.

b. Installation

1. Position cylinder and bracket on parking brake assembly and secure with one rivet or bolt and nut.
2. Secure link to manual release lever.
3. Install parking brake assembly as described in Note 20b.
4. Test lock and automatic release operations with engine running in Neutral and Drive ranges.

(NOTE: Parking brake should release in any drive range with engine running, and should remain engaged in Neutral and Park with engine running.)

22. Parking Brake Cables (Fig. 5-22)

a. Removal (Front Cable)

1. Release parking brake.
2. Disconnect cable stud at equalizer by removing equalizer nut and washer and separating cable stud from equalizer.
3. Remove U-shaped retainer at frame.
4. Remove U-shaped retainer at pedal assembly.
5. Remove cable end from parking brake assembly clevis.
6. Pull cable through hole in frame and remove from car.

b. Installation (Front Cable)

1. Insert cable through hole in body.
2. Install cable end into clevis in pedal assembly.
3. Install U-shaped retainer at pedal assembly.
4. Install cable grommet into hole in body.
5. Insert cable through hole in frame.
6. Install U-shaped retainer.
7. Connect cable stud at equalizer by installing washer and nut.
8. Check operation of parking brake system and adjust if necessary as outlined in Note 8.

c. Removal – Center Cable

1. Release parking brake.
2. Remove equalizer nut and washer from cable stud and remove equalizer.
3. Remove retainer securing cable conduit at cross member and remove cable from bracket.
4. Remove wire guide from cross member.
5. Remove retainer from right body bracket and remove cable from bracket.
6. Remove wire guide from left frame side rail.
7. Remove cable from right and left connectors and remove cable.

d. Installation – Center Cable

1. Install cable in right and left connectors.
2. Install wire guide securing cable to left frame side rail.
3. Install cable conduit in right body bracket and secure with retainer.
4. Install wire guide securing cable conduit at cross member.
5. Install cable conduit in bracket at cross member and secure with retainer.
6. Install cable in equalizer and secure to cable stud with nut and washer.
7. Check operation of parking brake and adjust if necessary as described in Note 8.

e. Removal – Rear Cables (All Except 693)

1. Release parking brake.
2. Raise rear of car and place on jack stands.
3. Remove rear wheel and drum on same side of car as parking brake cable being replaced.
4. Remove equalizer nut and washer, and separate equalizer from front cable stud.
5. Remove end of cable being replaced from C-clamp.
6. Remove horseshoe clip securing cable to control arm bracket and remove cable from bracket by pulling rearward.
7. Remove two screws securing parking brake cable clamp to brake backing plate.
8. Remove pawl spring and pawl lever from actuating lever.
9. Remove cable end from operating lever, and remove cable from backing plate.

f. Installation–Rear Cables (All Except 693)

1. Route cable end through rear of backing plate and install on operating lever.
2. Install pawl lever and pawl spring.
3. Position parking brake cable clamp against backing plate, securing with two screws. Tighten screws to 11 foot-pounds maximum torque.

CAUTION: Check operation of cable and brake shoes by pulling on front end of cable.

4. Route cable over top of rear suspension lower control arms.
5. Insert cable through hole in control arm bracket and secure with horseshoe clip.
6. Install cable end in C-shaped clamp.
7. Insert front cable stud through equalizer hole and install equalizer washer and nut.
8. Install rear drum and wheel.
9. Adjust parking brake as described in Note 8.

HYDRAULIC LINES

23. Brake Combination Valve (Except 693)

a. Removal

1. Disconnect wiring connector from valve.
2. Disconnect three brake pipes from top and one from front of valve.
3. Raise car and disconnect remaining brake pipe from bottom of valve.
4. Remove two bolts securing valve to frame and remove valve.

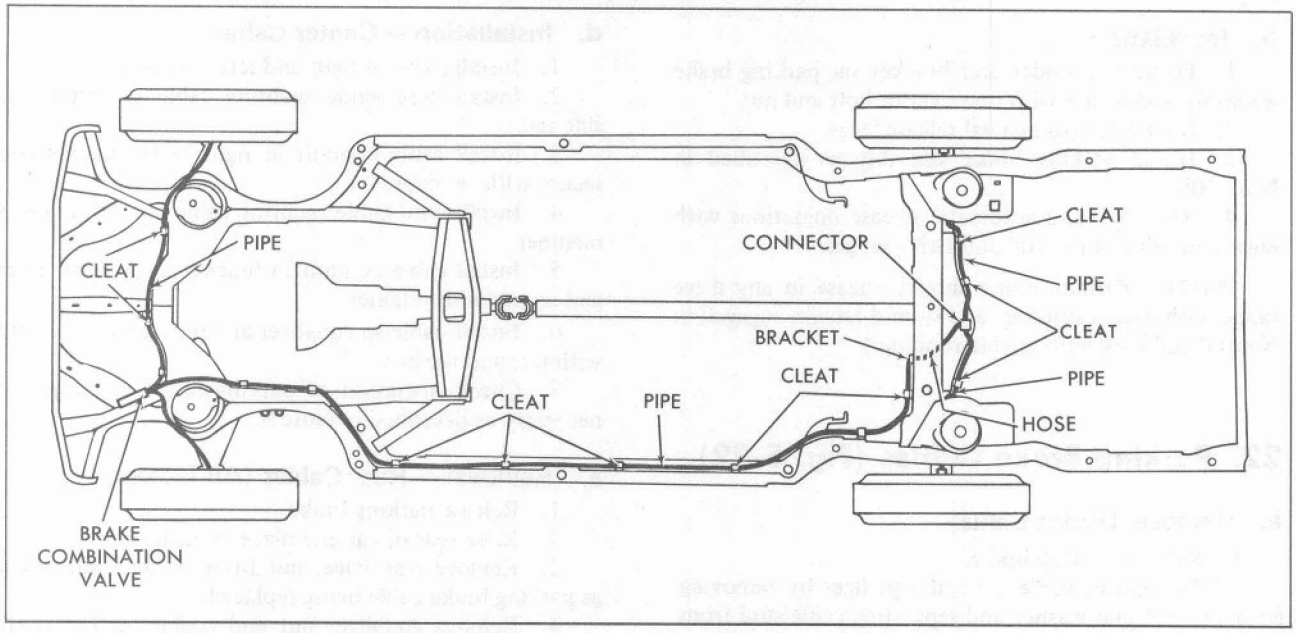


Fig. 5-23 Hydraulic Brake Lines

b. Installation

1. Position valve to frame and secure with two bolts.
2. Install brake pipe to bottom of valve.
3. Lower car.
4. Install one brake pipe to front of valve and three on top.
5. Connect wiring connector to valve.
6. Bleed brakes as described in Note 6.

24. Servicing Hydraulic Brake Hoses and Piping—(All Except 693, Fig. 5-23)

The brake system should be checked visually each time the car is lubricated. When the car is raised on a lift for lubrication, brake lines, hoses, and cables should be inspected for proper attachment, leaks, cracks, chafing, deterioration, etc.

The brake hoses should be carefully inspected for cracks in the rubber cover (360° around) at either end of the hose near the fittings by flexing the hose while inspecting it. Adequate lighting and a mirror are essential tools for a good inspection. This inspection is made easier by steering the wheels to a full turn and/or removing the front wheels. If any cracks, chafing, or leaks of the brake hose are detected, the brake hose should be replaced.

a. Removal—Hydraulic Brake Hose (Front Wheels)

1. Disconnect steel brake line from hose. Cap fitting to prevent dirt from entering brake line.
2. Remove U-shaped retainer from hose fitting and withdraw hose from frame support bracket.
3. Turn hose fitting out of caliper inlet and remove copper gasket. Discard gasket. If hose is to be reinstalled, cover end fittings to prevent dirt from entering hose.

b. Installation—Hydraulic Brake Hoses (Front Wheels)

1. Install new copper gasket on caliper end of hose (male end). Tighten hose in caliper inlet to 30 foot-pounds maximum torque.

CAUTION: Never tighten hose in caliper inlet with hose attached at frame ends as this will twist the hose.

2. With suspension in normal position (front wheels straight ahead) pass female end of hose through frame support bracket, allowing hose to seek its own position. Insert hex of hose fitting into the 12-point hole in support bracket in position that will result in least twist in hose.

(NOTE: Do not twist hose any more than necessary during this operation as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.)

3. Install U-shaped retainer to secure hose in frame support bracket.
4. Inspect by turning steering from stop-to-stop while observing hose position be sure that hose does not touch other parts at any time during steering travel. If contact does occur, remove hose retainer and rotate female hose end in support bracket one or two points in appropriate direction, replace retainer, and reinspect.
5. Place steel tube connector nut in hose fitting and tighten to 20 foot-pounds maximum torque.
6. Bleed all brakes as outlined in Note 6.

c. Removal—Hydraulic Brake Hose (Rear Wheels

1. Disconnect brake pipes from hose. Cap pipes to prevent entry of dirt or foreign matter into system.
2. Remove retainer securing forward end of hose to bracket.
3. Remove screw securing hose to axle bracket.

d. Installation—Hydraulic Brake Hose (Rear Wheels)

1. Thread rear axle pipes into hose.
2. Install brake hose mounting screw and torque to 12 foot-pounds.
3. Pass forward end of hose through mounting hole in frame allowing hose to seek its own position. Insert barrel end of hose fitting into barrel hole in mounting bracket and install retainer.
4. Remove line caps and tighten pipe nuts to 20 foot-pounds maximum torque.
5. Bleed brakes as described in Note 6.

e. Removal—Hydraulic Brake Piping (Rear Wheels)

1. Disconnect steel brake piping at rear wheel cylinder fitting. Cap fitting to prevent dirt from entering wheel cylinder.
2. Disconnect brake piping at brake hose on axle housing.
3. Unbend from welded retainer(s) on axle housing, and remove piping.
4. Remove screw securing pipe cleat to upper control arm bracket (R.H. only), remove piping.

f. Installation—Hydraulic Brake Piping (Rear Wheels)

1. Install steel piping on welded retainers.
2. Connect piping at brake hose and tighten to 20 foot-pounds maximum torque.
3. Connect piping at wheel cylinder fitting, tightening to 20 foot-pounds maximum torque.
4. Bend welded retainer(s) over piping enough to secure, being careful not to damage brake piping.
5. Install screw and pipe cleat securing piping to R.H. upper control arm bracket.
6. Bleed all brakes as outlined in Note 6.

25. Hydraulic Brake Tubing

Hydraulic brake tubing is a double layer annealed steel terne plate tubing which resists corrosion and has the physical strength to stand up under the high pressures which are developed when applying the brakes. In making up hydraulic brake pipes, it is recommended that Flaring Tool No. J-23530 be used to double-lap flare the ends of the tubing. Unless the tubing is properly flared, the connections will leak and the brakes will become ineffective.

CAUTION: When necessary to replace brake tubing, always use special steel tubing which is designed to withstand high pressure and resist corrosion. Ordinary copper tubing is not satisfactory and should not be used.

This safety steel tubing must be double-lap flared at the ends in order to produce a strong leak-proof joint.

Figure 5-24 shows two pieces of tubing, one with single-lap flare "A" and the other with double-lap flare "B". It will be noted that the single-lap flare in "A" split the tubing while the one shown in "B" is well-formed and unbroken due to the reinforcement of the double wall.

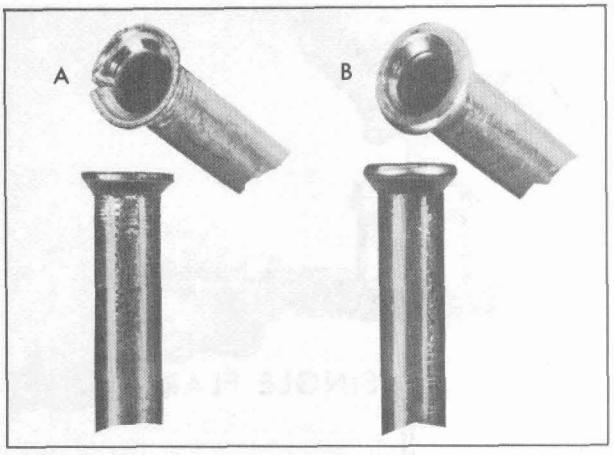


Fig. 5-24 Single and Double Lap Flair

The following procedure should be followed in making up hydraulic brake pipes.

26. Double Lap Flaring

1. Cut the tubing to the desired length.
2. Cut end square and clean burrs from inside and outside of tubing to be flared.
3. Using Tool No. J-23530, unscrew compression screw until swivel cone is at its highest point; swing strap to one side.
4. Open lever handle so it is at right angle to rest of tool, and revolve hexagonal tube clamps to accommodate tubing. (Selection of six sizes).
5. Be sure tubing nut is properly placed on tubing. Insert end of tube between two blocks until level with top of gage, Fig. 5-25.
6. Insert proper pin of gage into tubing and swing strap back in closed position. Tighten compression screw until gage bottoms on tool, Fig. 5-26, then unscrew compression screw and swing strap to one side. Remove gage.
7. Swing strap back in closed position, then tighten compression screw to flare cone downward to complete double-lap flare, Fig. 5-27.

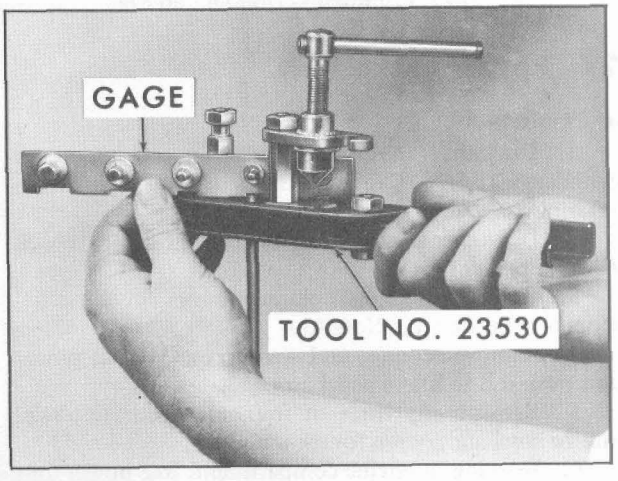


Fig. 5-25 Placing Tubing in Tool

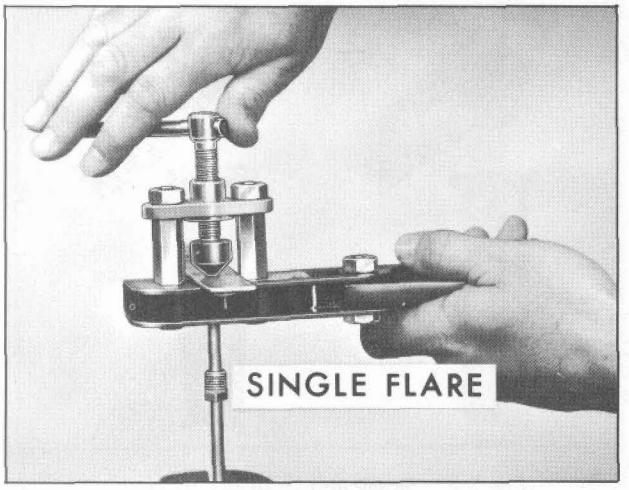


Fig. 5-26 Preparing for Double Lap

8. Unscrew compression screw and open smaller lever handle to remove tubing.

9. Inspect flared ends for splits, cracks, pits or excessive out of round which may cause leaks.

10. Blow tubing out with dry compressed air to remove any foreign objects.

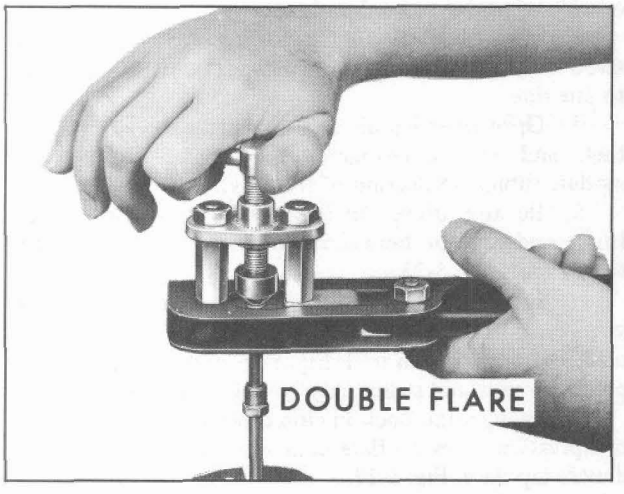


Fig. 5-27 Completing Double Lap Flair

27. Power Brake Unit

a. Removal

1. Disconnect hydraulic brake lines from master cylinder, Fig. 5-28. Cap line fittings to prevent dirt from entering brake lines.

2. Disconnect vacuum hose from vacuum check valve on power head.

3. Remove steering column lower cover as described in Section 12, Note 41a.

4. Remove retainer and washer that attach power unit push rod to brake pedal arm.

5. Remove any three of four nuts securing power unit to cowl and loosen fourth nut.

6. Working in engine compartment, free power unit from cowl.

7. Disconnect brake unit push rod from brake pedal arm. Remove spring spacer from brake pedal arm.

8. Remove remaining nut retaining power unit to cowl, and remove power unit gaskets and spacer from engine compartment.

b. Installation

1. Position power unit gaskets and spacer to cowl.

2. Working inside passenger compartment, loosely install four nuts retaining power unit to cowl.

3. Install spring spacer, push rod and washer on brake pedal arm and secure with retainer.

4. Tighten four nuts that hold the power unit to 16 foot-pounds.

(See CAUTION page 5-8 prior to Note 6.)

5. Install steering column lower cover as described in Section 12, Note 41b.

6. Connect vacuum hose to check valve on power unit.

7. Secure hydraulic brake lines to master cylinder to 20 foot-pounds maximum.

8. Bleed brakes as described in Note 6.

28. Master Cylinder Disassembly, Cleaning, Inspection and Assembly (Fig. 5-29)

a. Disassembly

(NOTE: If trouble has been traced to hydraulic system, master cylinder may be removed from power head without removing power head from car. Area surrounding master cylinder mounting surface must be kept clean.)

1. Disconnect and cap front and rear brake lines if not done previously.

2. Remove two self-locking nuts that hold master cylinder to power head and remove master cylinder.

3. Pry bale type retainers off of reservoir cover, and

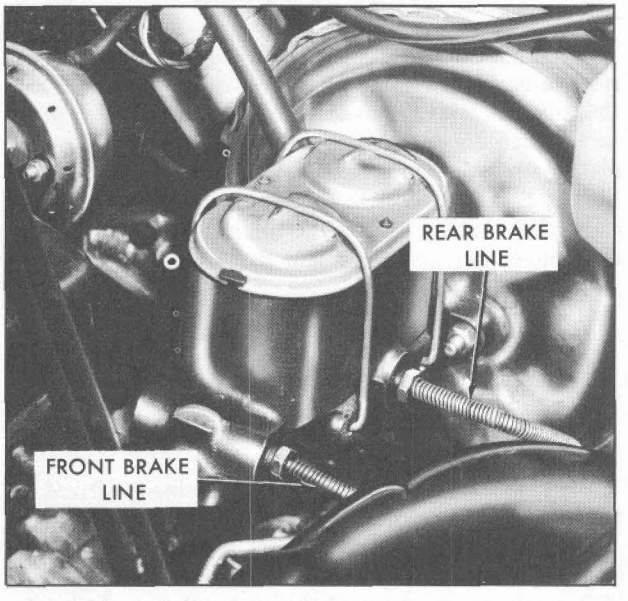


Fig. 5-28 Power Brake Unit

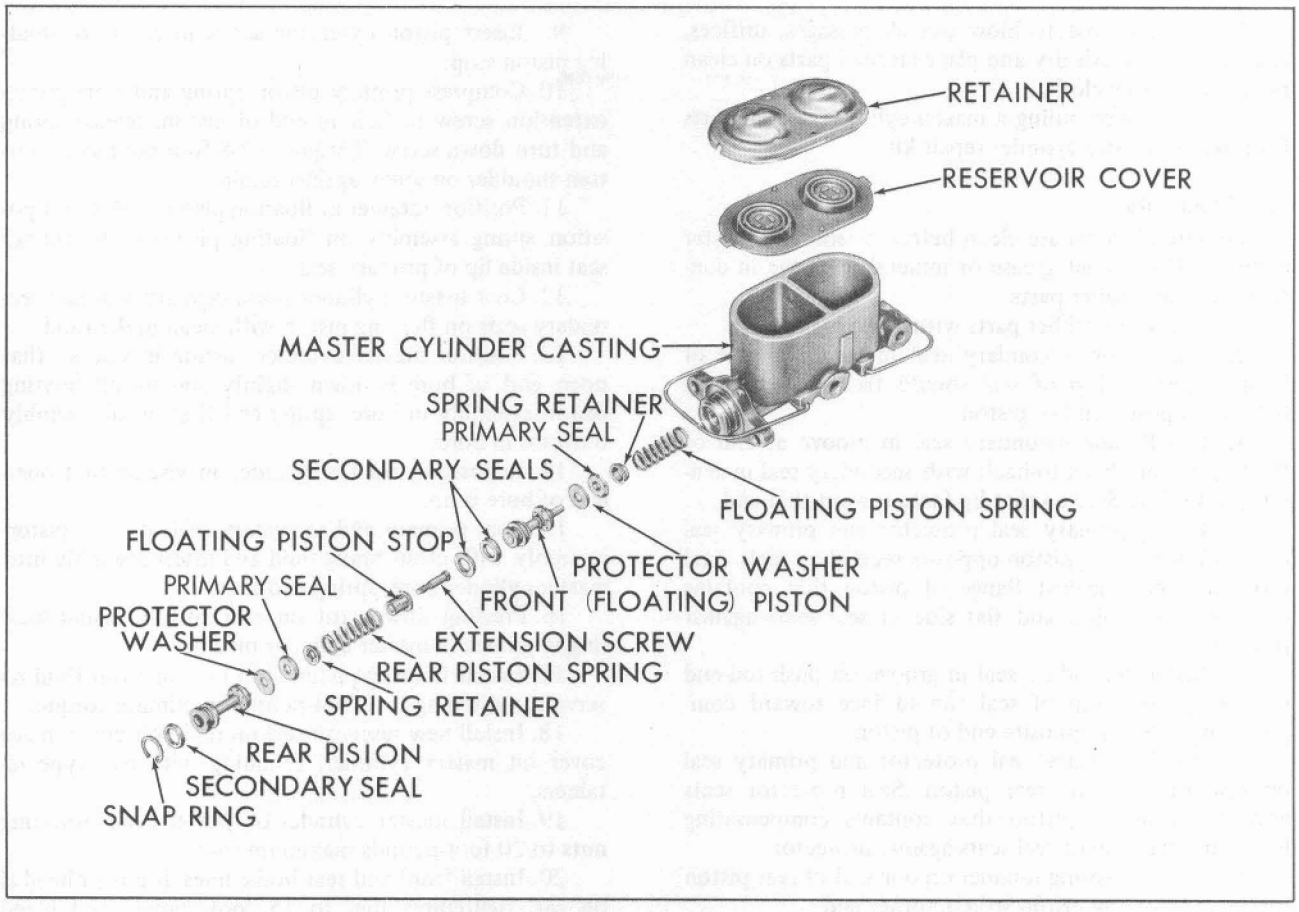


Fig. 5-29 Master Cylinder Disassembled

remove reservoir cover and seal. Drain brake fluid from reservoirs.

4. Remove seal from reservoir cover.

5. Remove floating piston stop bolt from front fluid reservoir.

6. Remove lock ring from open end of master cylinder and remove rear piston assembly, Fig. 5-29.

7. Firmly rap master cylinder on a block of wood until floating piston drops in bore and remove front (floating) piston assembly, retainer and spring.

CAUTION: Check progress of floating piston dropping in bore to avoid striking piston on wood. If floating piston sticks in bore, blow dry compressed air through front brake outlet hole.

8. Place master cylinder in vise with outlet holes up being careful not to damage reservoir seal surface of casting.

9. Remove the primary seal, primary seal protector and secondary seals from the front (floating) piston.

10. Remove piston extension screw from center of loating piston stop and remove floating piston stop and spring from rear piston.

(NOTE: If necessary, grasp the unfinished piston body immediately under flange containing holes with a pair of pliers to remove piston extension screw.)

11. Remove spring retainer, primary seal, primary seal protector and secondary seal from the rear piston.

b. Cleaning and Inspection

1. Inspect master cylinder bore for scoring, pitting or etching. Any of these will require replacement of master cylinder casting.

2. Examine fluid reservoir for foreign matter, and check all passages for restrictions. If there is any suspicion of contamination or evidence of corrosion, completely flush hydraulic system, using clean brake fluid.

(NOTE: A grease like silicone substance may be found inside the brake master cylinder when it is being overhauled. This substance is used by the manufacturer as a lubricant to provide smooth brake actuation. It is a normal condition and need not be cleaned out of the master cylinder before reassembly.)

3. Inspect floating piston for severe scoring, pitting, or distortion. Any of these will require replacement of master cylinder assembly.

(NOTE: Floating piston may show a wear pattern; however, do not replace assembly unless wear is severe.)

4. Thoroughly wash all parts (except the inside of master cylinder) in clean alcohol, including new parts to be used in assembly of master cylinder but do not wash silicone out of master cylinder.

CAUTION: Use of gasoline, kerosene, anti-freeze, or any cleaner with even a trace of mineral oil will damage rubber parts.

5. Use air hose to blow out all passages, orifices, and valve holes. Air dry and place cleaned parts on clean paper or lint-free cloth.

6. When overhauling a master cylinder, use all parts furnished in master cylinder repair kit.

c. Assembly

Be sure all parts are clean before assembling master cylinder. Do not let grease or mineral oil come in contact with any rubber parts.

1. Lubricate rubber parts with clean brake fluid.

2. Install new secondary seal in center groove of floating piston. Lip of seal should face compensating holes in opposite end of piston.

3. Install new secondary seal in groove at end of floating piston, back-to-back with secondary seal in center groove, Fig. 5-29 so that lip faces toward that end.

4. Install primary seal protector and primary seal over end of floating piston opposite secondary seals. Seal protector seats against flange of piston that contains compensating holes, and flat side of seal seats against protector.

5. Install secondary seal in groove on push rod end of rear piston. Lip of seal should face toward compensating holes in opposite end of piston.

6. Install primary seal protector and primary seal on opposite end of rear piston. Seal protector seats against flange of piston that contains compensating holes, and flat side of seal seats against protector.

7. Position spring retainer on one end of rear piston spring and floating piston stop on other end.

8. Position spring assembly on rear piston with spring retainer seated inside lips of primary seal.

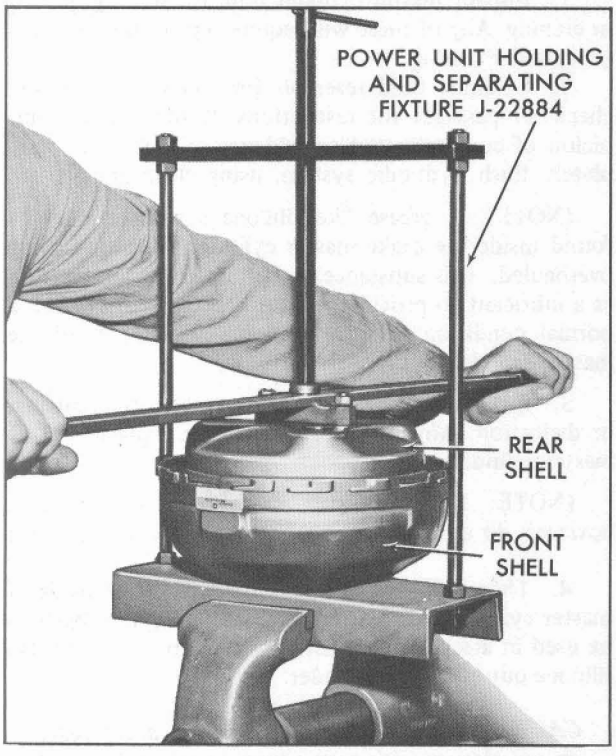


Fig. 5-30 Removing Rear Shell

9. Insert piston extension screw in center of floating piston stop.

10. Compress primary piston spring and start piston extension screw in hole in end of piston, release spring and turn down screw. Torque to 7-8 foot-pounds to bottom shoulder on screw against retainer.

11. Position retainer in floating piston spring and position spring assembly on floating piston with retainer seat inside lip of primary seal.

12. Coat master cylinder bore, primary seal and secondary seals on floating piston with clean brake fluid.

13. Position master cylinder casting in vise so that open end of bore is down slightly and install floating piston assembly in bore, spring end first, until assembly bottoms in bore.

14. Reposition master cylinder in vise so that open end of bore is up.

15. Coat primary and secondary seals on rear piston assembly with clean brake fluid and insert assembly into master cylinder bore, spring end first.

16. Pressing downward on rear piston, install lock ring in groove in master cylinder piston.

17. Install floating piston stop bolt in front fluid reservoir, tightening to 3 foot-pounds maximum torque.

18. Install new reservoir seal on reservoir cover, place cover on master cylinder, retaining with bale-type retainers.

19. Install master cylinder on power head, torquing nuts to 20 foot-pounds maximum torque.

20. Install front and rear brake lines, if power head is on car, tightening lines to 15 foot-pounds and bleed brakes as described in Note 6.

29. Power Head Disassembly, Cleaning, Inspection and Assembly

a. Disassembly

(NOTE: Scribe mark on top center of front and rear housings in line with master cylinder reservoir cover to facilitate reassembly.)

1. Remove master cylinder reservoir cover retainers, reservoir cover and diaphragm, and empty brake fluid from reservoirs.

2. Remove two locknuts which hold master cylinder to front housing, and remove master cylinder from its mounting studs. Remove front housing seal from front shell.

(NOTE: If Separating Fixture, J-22884, is not available, use Separator, J-9504. Do not remove master cylinder at this time if J-9504 is to be used.)

3. Secure Power Unit Shell Holding and Separating Fixture, J-22884, and power head, Fig. 5-30. Studs on rear shell engage base of fixture and studs on front shell engage bar of tool with bar bearing against front shell. Secure front shell to bar with two master cylinder lock nuts.

4. Rotate bar counterclockwise and unlock shells.

5. Back off on hold down clamp sufficiently to remove front shell, return spring, retaining plate and piston rod retainer, Fig. 5-31 and 5-32.

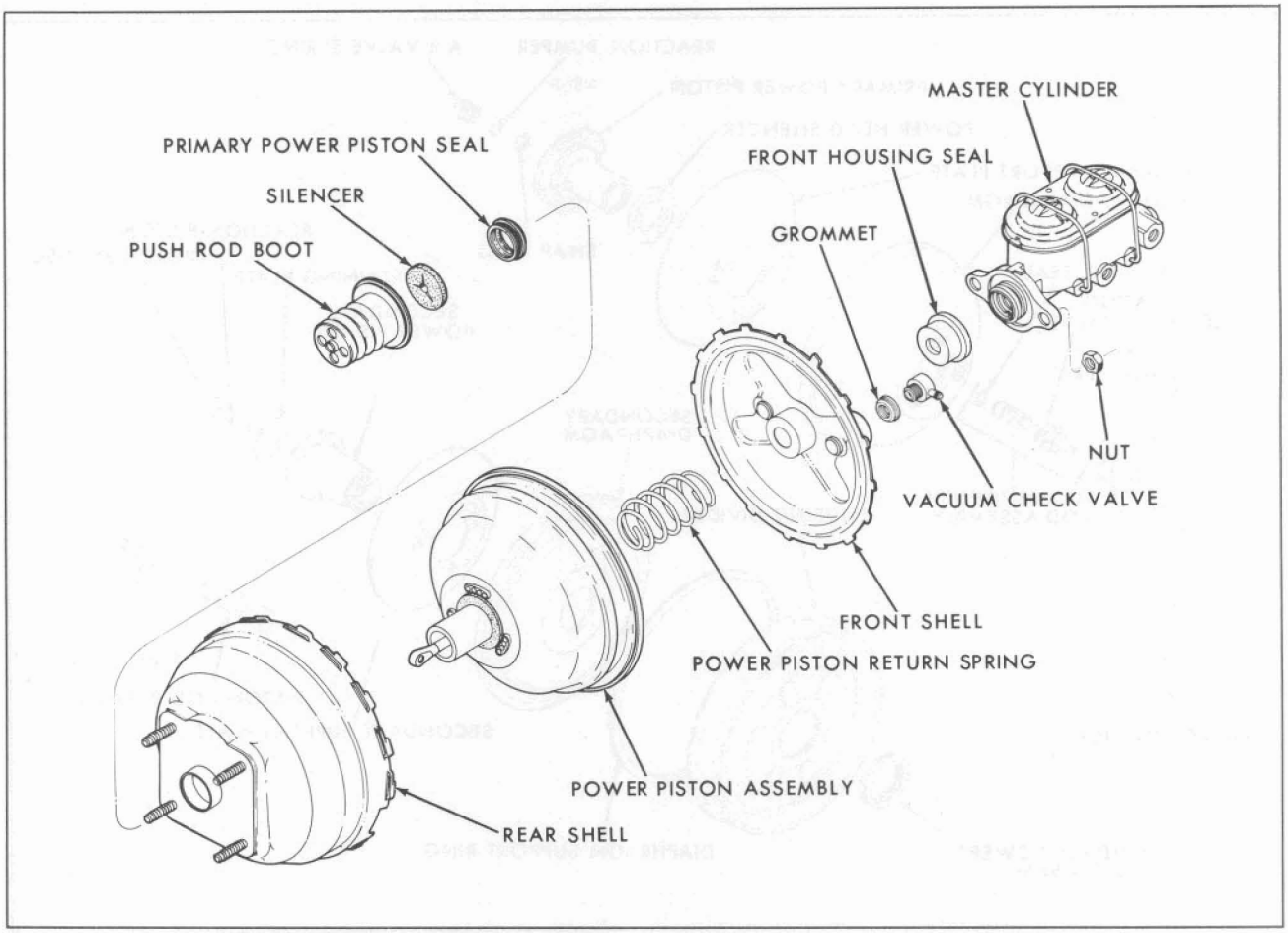


Fig. 5-31 Power Head Disassembled

CAUTION: Be careful when separating diaphragms that return spring does not fly out.

6. Remove vacuum check valve and grommet from front shell.

7. Remove assembly from holding fixture and remove J-22884 from vise.

8. Remove dust boot retainer and boot from rear housing and push rod. Remove felt silencer from inside the boot.

9. Remove power piston assembly from rear shell and remove primary power piston seal from center opening of rear shell.

10. Lift bead on outside diameter of secondary diaphragm and remove diaphragm support ring, Fig. 5-32.

11. Mount Holding Fixture, J-23101, in a vise with wide jaws up. Position secondary power piston so that two radial slots in piston fit over jaws of tool, Fig. 5-33.

12. Fold back primary diaphragm from outside diameter of primary support plate. Grip edge of support plate and rotate counterclockwise to unscrew primary piston from secondary power piston, Fig. 5-34.

(NOTE: It is possible that primary support plate will unlock from primary piston before primary piston unscrews from secondary piston. If this happens, continue to turn primary support plate counterclockwise. Tabs ("stops") on primary support plate will temporarily lock primary support plate to primary power piston and permit continued counterclockwise rotation to unscrew primary power piston from secondary power piston.)

13. Remove air valve spring from secondary power piston or end of air valve.

14. Remove housing divider from secondary power piston. Remove secondary power piston seal from housing divider.

15. Secondary power piston should still be positioned on Tool J-23101. Fold back secondary diaphragm from O.D. of secondary support plate. Grip edges of support plate and rotate clockwise to unlock secondary support plate from secondary power piston, Fig. 5-35.

16. Remove secondary diaphragm and support plate and separate.

17. Remove reaction piston and reaction disc from center of secondary power piston by holding it in hand and pushing down on end of reaction piston with a small object, such as a pencil, wooden dowel or metal rod, Fig. 5-36.

18. Mount Tool J-23101 in vise with small jaws up. Position primary power piston so two radial slots in piston fit over jaws of tool, Fig. 5-37.

19. Fold back primary diaphragm from support plate. Grip edge of support plate and rotate in a counterclockwise direction to unlock primary support plate from primary power piston, Fig. 5-38.

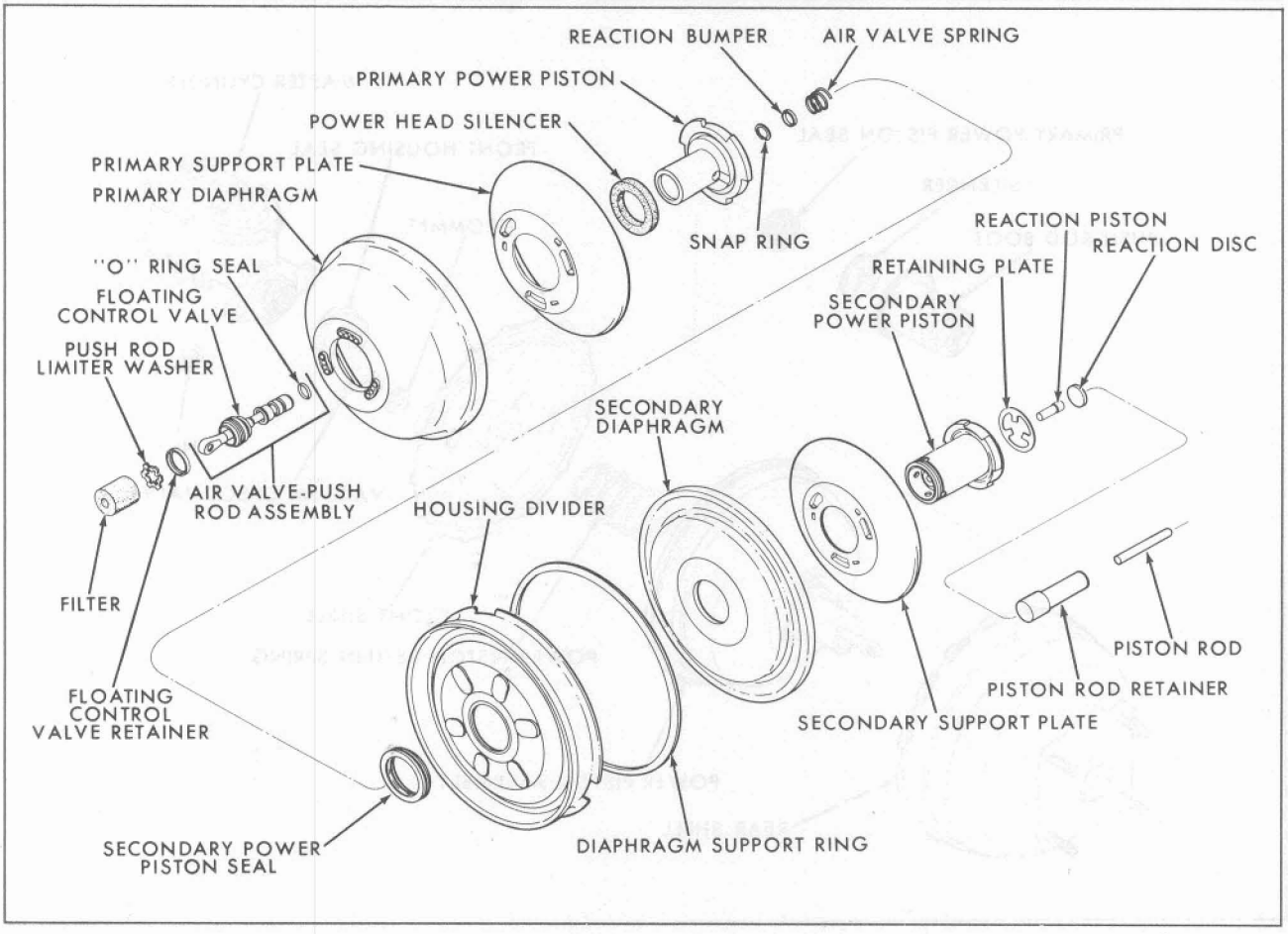


Fig. 5-32 Power Piston Disassembled

20. Remove primary diaphragm from primary support plate.

21. Remove air filter and push rod limiter washer from tubular section of primary power piston, Fig. 5-32.

22. Remove power head silencer from neck of power piston tube.

23. Remove rubber reaction bumper from end of air valve.

24. Clamp eyelet end of air valve push rod in side of vise and using Snap Ring Pliers, J-4880 remove snap ring from air valve, Fig. 5-39.

25. Remove air valve-push rod assembly from tube

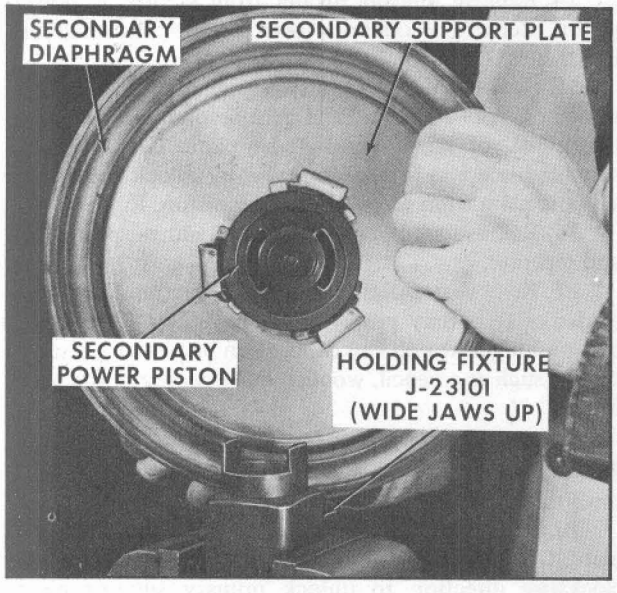


Fig. 5-33 Positioning Secondary Power Piston

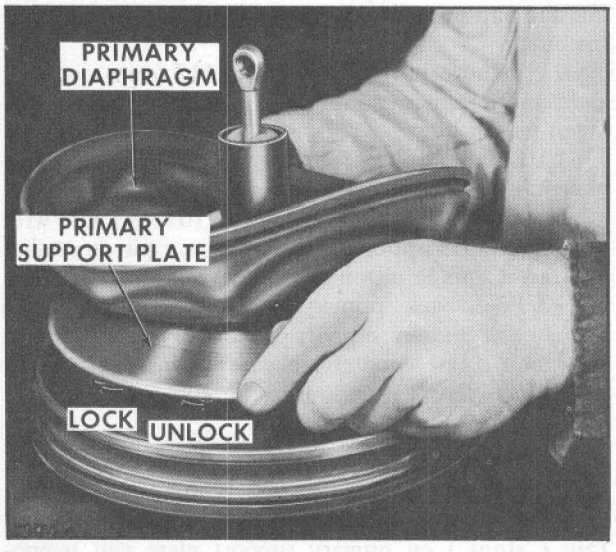


Fig. 5-34 Loosening Power Pistons

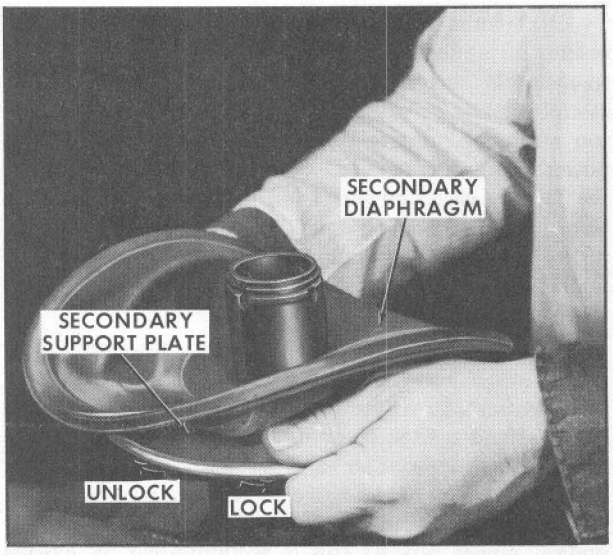


Fig. 5-35 Removing Secondary Diaphragm

end of primary power piston by pulling on primary power piston. A considerable force will be required.

Removal of air valve push rod assembly will disassemble control valve retainer.

26. Remove "O" ring seal from air valve.

Air valve push rod assembly is serviced as a complete assembly, since floating control valve cannot be removed over end of push rod.

b. Cleaning and Inspection

1. Thoroughly wash all parts in clean alcohol.

CAUTION: Use of gasoline, kerosene, anti-freeze or any cleaner with even a trace of mineral oil will damage rubber parts.

2. Use air hose to blow out all passages, orifices, and valve holes. Air dry and place cleaned parts on clean paper or lint-free cloth.

3. If any rust is found inside front or rear shell, polish clean with crocus cloth or fine emery paper, washing clean afterwards.

4. Inspect front and rear shells for scratches, scores, pits, dents or other damage affecting rolling or sealing of diaphragm or other seals. Small imperfections may be smoothed out with fine crocus cloth.

5. Inspect all original parts, not being replaced by repair kit, for damage, distortion or excessive wear and chips, and replace as necessary.

6. Use all parts furnished in power head repair kit.

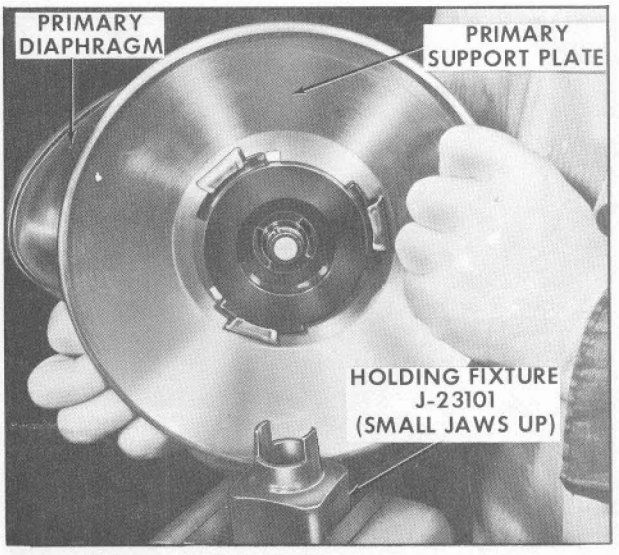


Fig. 5-37 Positioning Primary Power Piston

c. Assembly

1. Lubricate I.D. and O.D. of "O" ring seal, Fig. 5-32 with silicone lubricant and place on air valve.

2. Wipe a thin film of silicone lubricant on large and small O.D. of floating control valve.

3. If floating control valve needs replacement, it will be necessary to replace complete air valve push rod assembly, since floating control valve is a component

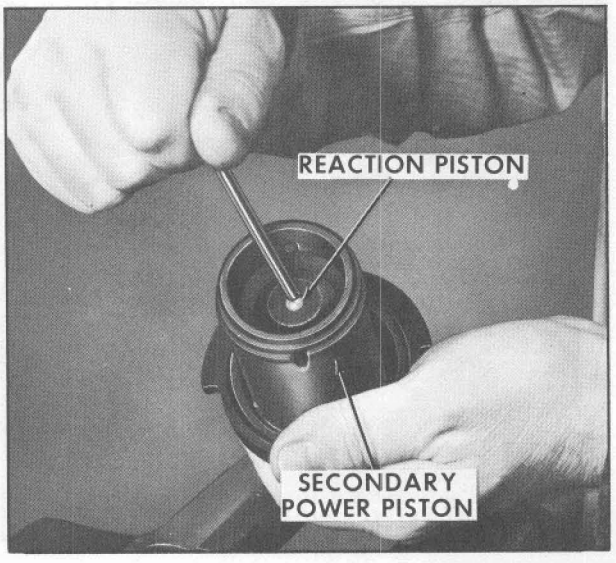


Fig. 5-36 Removing Reaction Piston

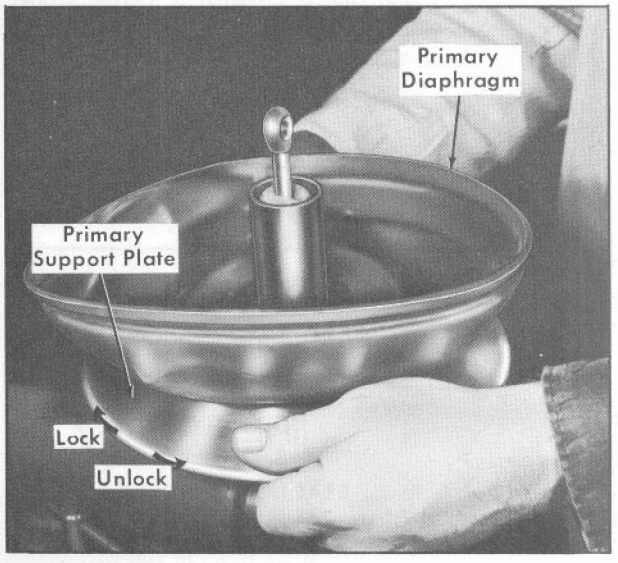


Fig. 5-38 Removing Primary Diaphragm

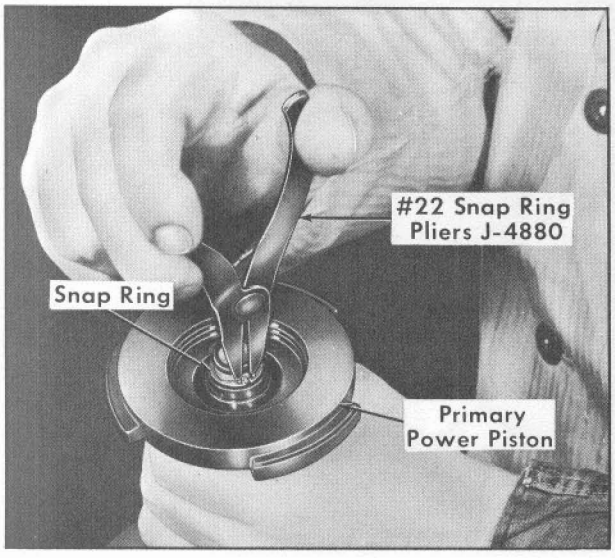


Fig. 5-39 Removing Snap Ring From Air Valve

part of this assembly and cannot be disassembled from push rod.

4. Place air valve end of air valve push rod assembly into tube of primary power piston. Manually press air valve push rod assembly so that floating control valve bottoms on tube section of primary power piston.

5. Place I.D. of floating control valve retainer on O.D. of Control Valve Retainer Installer, J-23175. Place over push rod so that closed side of retainer seats on floating control valve. With Installer, J-23175, manually press retainer and floating control valve assembly to seat in primary power piston tube, Fig. 5-41.

6. After floating control valve is seated, place push rod limiter washer over push rod and position on floating control valve, Fig. 5-32.

7. The filter element can now be stretched over push rod eye and pressed into primary power piston tube, Fig. 5-32.

8. Using Snap Ring Pliers, J-4880, place snap ring in its air valve groove, Fig. 5-39.

(NOTE: If snap ring is installed in O-ring groove, power pistons will not thread together all the way and threads may be damaged.)

9. Position rubber reaction bumper on end of air valve.

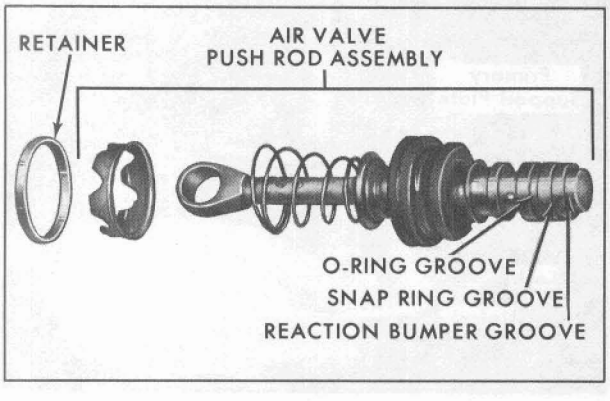


Fig. 5-40 Floating Control Valve

10. Tolerances of those component parts affecting output of tandem power brake are very critical. In order to maintain correct power brake output, power piston assembly must be gaged for selective fit of reaction piston whenever primary power piston, and/or secondary power piston are replaced during servicing. When using the factory gaged power piston kit containing both the primary and secondary power pistons with one reaction piston, the gaging operation will not be necessary. This gaging operation is not required if neither power piston is replaced during servicing.

If neither primary power piston nor secondary power piston has been replaced, proceed to Step 18. If any of above parts have been replaced, proceed with Step 11.

11. Hand tighten secondary power piston to primary power piston without air valve spring.

12. Obtain three selective fit reaction pistons and insert one of the reaction pistons into its cavity in secondary power piston. This is accomplished by placing reaction piston, small diameter first, through large cavity and into small cavity.

13. With secondary power piston pointing up, push on the reaction piston to insure that air valve is properly positioned.

14. While holding primary power piston in one hand, place Gage J-23235 in secondary power piston so that outer edges rest on bottom of large cavity, with two gaging levels within small reaction piston cavity, Fig. 5-42.

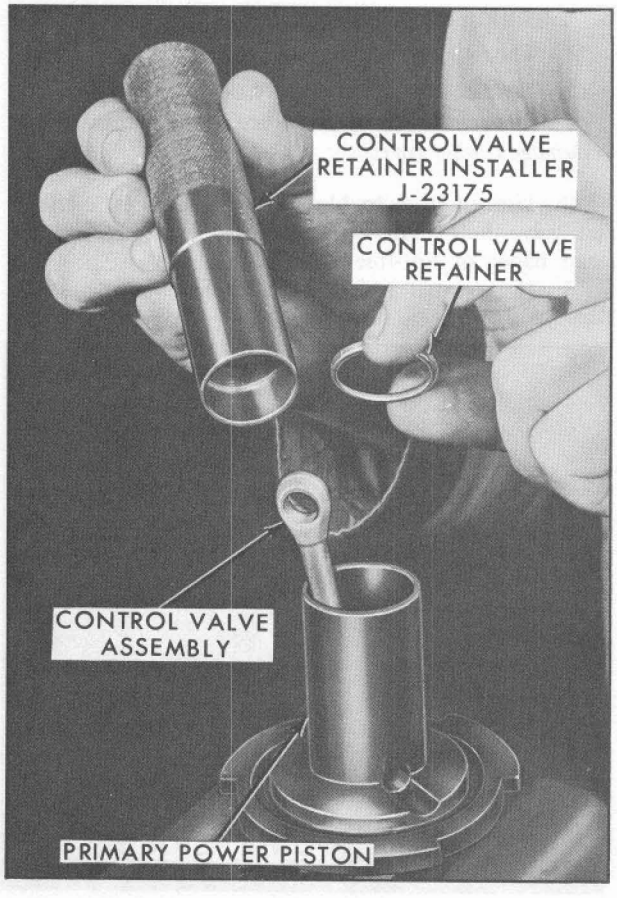


Fig. 5-41 Installing Retainer Ring

15. Move the gage to the left or right of reaction piston "nose". Correct size reaction piston is indicated when piston "nose" hits low level and clears high level while permitting outer edges of gage to touch the large cavity of the secondary power piston, Fig. 5-42.

If reaction piston is long, high level will not clear "nose" with outer edges of gage touching large cavity of secondary power piston. If reaction piston is short, both levels will clear reaction pose "nose", Fig. 5-42.

(NOTE: Care must be taken so gage is not "cocked".)

16. Repeat steps 12 through 15 using a different reaction piston until correct size piston is installed.

17. Unlock secondary power piston from primary power piston and proceed with step 18.

18. Apply a light film of silicone lubricant to O.D. of rubber reaction disc. Place disc in small cavity of the secondary power piston and push disc down to seat on reaction piston.

19. Assemble primary diaphragm to primary support plate from side of plate opposite locking tangs, Fig. 5-32. Press raised flange on I.D. of diaphragm through center hole of support plate. Be sure edge of support plate center hole fits groove in raised flange of diaphragm. Lubricate diaphragm I.D. and raised surface of flange that fits into a groove in the primary power piston with light coat of silicone lubricant.

20. Mount Holding Fixture, J-23101, in vise, small jaws up. Position primary power piston so two radial slots in piston fit over jaws of tool, Fig. 5-37.

21. Fold primary diaphragm away from O.D. of the primary support plate.

22. Holding edges of the support plate, with the locking tangs down, place primary support plate and diaphragm assembly over tube of primary power piston. Flange on the I.D. of primary diaphragm will fit groove in the primary power piston.

23. Grip edges of primary support plate, press down, and rotate clockwise until tabs on primary power piston contact stops on support plate, Fig. 5-38.

24. Place power head silencer on tube of primary power piston so holes at the base of tube are covered.

25. Apply a very light film of silicone lubricant to O.D. of primary power piston tube.

CAUTION: Avoid applying excessive lubricant.

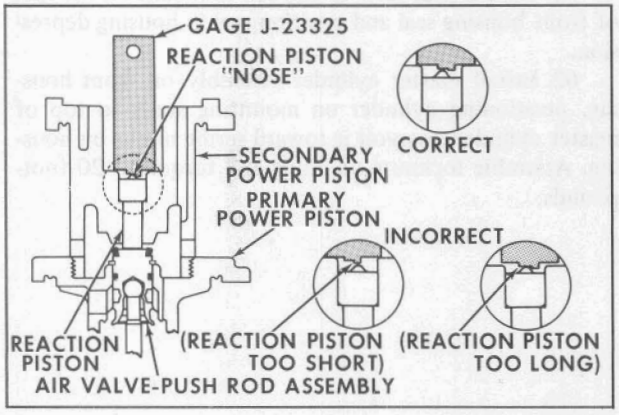


Fig. 5-42 Gaging Power Piston



Fig. 5-43 Installing Housing Divider

26. Remove primary piston assembly from Tool J-23101 and lay it aside.

27. Assemble secondary diaphragm to secondary support plate from side of support plate opposite locking tangs, Fig. 5-32. Press raised flange on I.D. of diaphragm through center hole of support plate. Be sure edge of support plate center hole fits groove in the raised flange of diaphragm. Apply thin coat of silicone lubricant to I.D. of secondary diaphragm and raised surface of flange (that fits into a groove in the secondary power piston).

28. Mount Tool J-23101 in vise with large jaws up. Position secondary power piston so radial slots in piston fit over jaws of tool, Fig. 5-33. Apply light coat of silicone lubricant to tube of secondary power piston.

29. Fold secondary diaphragm away from O.D. of secondary support plate.

30. Holding edges of the support plate, with locking tangs down, place secondary diaphragm and support plate assembly over tube of secondary power piston. Flange on I.D. of secondary diaphragm will fit secondary piston groove.

31. Grip edges of secondary support plate, press down, and rotate counterclockwise until tabs on secondary power piston contact stops on support plate, Fig. 5-34. Fold secondary diaphragm back into position on secondary support plate. Leave secondary power piston assembly on Tool J-23101 in vise.

32. Apply light coat of talcum powder or silicone lubricant to bead on O.D. of secondary diaphragm. This will facilitate assembly of front and rear housings.

33. Place secondary diaphragm support ring on the secondary power piston assembly so it rests on edge of diaphragm.

34. Hold the housing divider so the six impressions on middle of divider stick up. Install seal so part number can be read from this side.

35. Lubricate I.D. of secondary seal with silicone lubricant.

36. Position Secondary Seal Protector Tool, J-23188, on threaded end of secondary power piston, Fig. 5-43.

37. Hold the housing divider so the six impressions on middle of divider stick up. Press divider down over tool and onto secondary power piston tube where it will rest against the diaphragm support ring. Remove Seal Protector, J-23188, from secondary power piston; however, do not remove secondary power piston subassembly from Holding Fixture, J-23101.

38. Pick up primary power piston assembly and position small end of air valve return spring on air valve so it contacts air valve retaining ring.

39. Fold primary diaphragm away from O.D. of primary support plate.

40. Position primary power piston on tubular portion of secondary power piston, making sure small end of air valve return spring seats on air valve snap ring.

41. Grip edge of primary support plate, press down, and start threads on secondary power piston into threaded portion of primary power piston by rotating clockwise, Fig. 5-34.

42. Continue to tighten primary power piston until it is securely attached to secondary power piston.

43. Fold primary diaphragm back into position on primary support plate and pull diaphragm O.D. over formed lip of housing divider. Check to be sure bead on diaphragm is seated evenly around complete circumference.

44. Remove assembly from tool J-23101. Wipe a thin film of silicone lubricant on O.D. of piston rod retainer. Insert master cylinder piston rod retainer into secondary power piston cavity so flat end bottoms against rubber reaction disc in bottom of cavity.

45. Place primary power piston seal in rear housing center hold so formed flange of housing center hole fits groove of primary power piston seal. The part number of seal should show on inside of shell.

46. Coat I.D. of primary power piston seal with thin film of silicone lubricant.

CAUTION: Avoid applying excessive lubricant.

47. Mount Power Unit Holding and Separating Fixture, J-22884, in vise and position rear shell on tool so studs fit holes provided in tool.

48. Position power piston return spring over front shell inset.

49. Assemble power piston to rear shell by pressing primary power piston tube through rear housing seal. Press down until housing divider seats in the rear shell and primary power piston bottoms against shell.

50. Place piston rod retaining plate on end of power piston.

51. Install vacuum check valve grommet in front shell with large diameter outside.

52. Install vacuum check valve.

53. Hold front shell assembly (with mounting studs up) over rear shell. Position front shell so that when tangs on edge of front shell are locked in slots on edge of rear shell, scribe marks on top of shells will be in line.

54. Lower front shell assembly onto rear shell by tightening hold down clamp. Check to be sure piston rod retainer goes through center of retaining plate on power piston return spring. Retaining plate and power piston spring must seat in depression in face of secondary power piston. Check to be sure bead on O.D. of secondary diaphragm is positioned between edges of shells.

55. Continue to tighten clamp on front shell and fit tangs, in appropriate slots, on rear shell.

56. Rotate bar clockwise into locked position and remove power head from Holding Fixture, J-22884.

57. Place silencer in closed end of power head boot. Stretch boot over push rod and over flange in center of rear housing and install boot retainer.

58. Place power head assembly in vise with front shell facing up. Insert master cylinder piston rod, flat end first, into piston rod retainer.

59. Press down on master cylinder piston rod to be sure it is properly seated.

(NOTE: Remove front housing seal to assure that no vacuum is in power head while gaging.)

60. Place Gage, J-22647, over piston rod in a position which will allow gage to be slipped to left or right without contacting studs.

The center section of gage has two levels. The piston rod should always contact the long section (low level) of gage. The piston rod should never contact the short section (high level) of gage, Fig. 5-42. Move gage from side to side to check piston rod height.

Any variation beyond these two limits must be compensated for by obtaining an adjustable piston rod from your servicing Parts Distribution Center and adjusting self-locking screw to meet gaging specifications.

61. Wipe a thin film of silicone lubricant on the I.D. of front housing seal and position seal in housing depression.

62. Install master cylinder assembly on front housing, positioning cylinder on mounting studs so top of master cylinder reservoir is toward scribe marks on housing. Assemble locknuts on studs and torque to 20 foot-pounds.

SPECIFICATIONS

Item		All Series Except 693
Swept Braking Area (in square inches)		
Front		241
Rear		189
Lining Area (in square inches)		
Front		42
Rear		117
Wheel Cylinder Bore		
Rear – 680, 681, 682, 683 and 697		15/16"
Rear – 698		1"
Drums (inside diameter)		12.00"
Remachined Drum Diameter (maximum)		12.060"
Worn Drum Diameter (maximum)		12.090"
Variations of Inside Drum Diameter (maximum)		.0015"
Run-Out of Inside Drum Diameter (maximum)		.005"
Disc Thickness – minimum – Refinished		1.220"
– minimum – Worn		1.215"
Clearance Between Secondary Linings and Drums		.010" – .030"
Lateral Run-Out of Disc		.0025"
Flatness and Parallelism Between Frictional Surfaces of Disc		.0007"
Lining Size (length, width, thickness in inches)		
Front	Inner Shoe	5.4 x 1.93 x .43
	Outer Shoe	5.4 x 1.93 x .41
Rear Primary		11.00 x 2.50 x .24
Rear Secondary		12.36 x 2.50 x .26
Lining to Shoe Attachment Method		Rivets
Brake Combination Valve		
Front Brake Cut-in Pressure		130 psi
Front Brake Blend Pressure		650 psi
Rear Brake Proportioning Pressure – (except 697, 698 and Track Master)		41% above 350 psi
Rear Brake Proportioning Pressure with Track Master (Except 697 and 698)		41% above 470 psi
Failure Warning Differential Pressure		100-300 psi

TORQUE SPECIFICATIONS

Material Number	Application	Size	Foot-Pounds
Special	Pipe Nut to Master Cylinder	1/2 –20 or 9/16–18	25 Max.
Special	All Other Brake Pipe Nuts	3/8 –24, 7/16–24, 1/2 –20	20 Max.
260M	Parking Brake Cable Clamps (at Backing Plate)	5/16–24	11
Special	**Brake Hose to Caliper	7/16–20	30 Max.
300M	**Brake Backing Plate to Rear Axle Housing	7/16–20	50
284M	**Brake Unit to Cowl	3/8 –16	13
286M	Brake Pedal Pivot Bolt	7/16–20	13
286M	Master Cylinder to Vacuum Power Head	3/8 –24	20
Special	**Caliper to Steering Knuckle Bolt	Special	30
Special	Piston Extension Screw	Special	90*
Special	Floating Piston Stop Bolt	10–24	30*
	*Inch-Pounds		

(NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings and steel classifications.)

***CAUTION: This fastener is is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or sutstitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

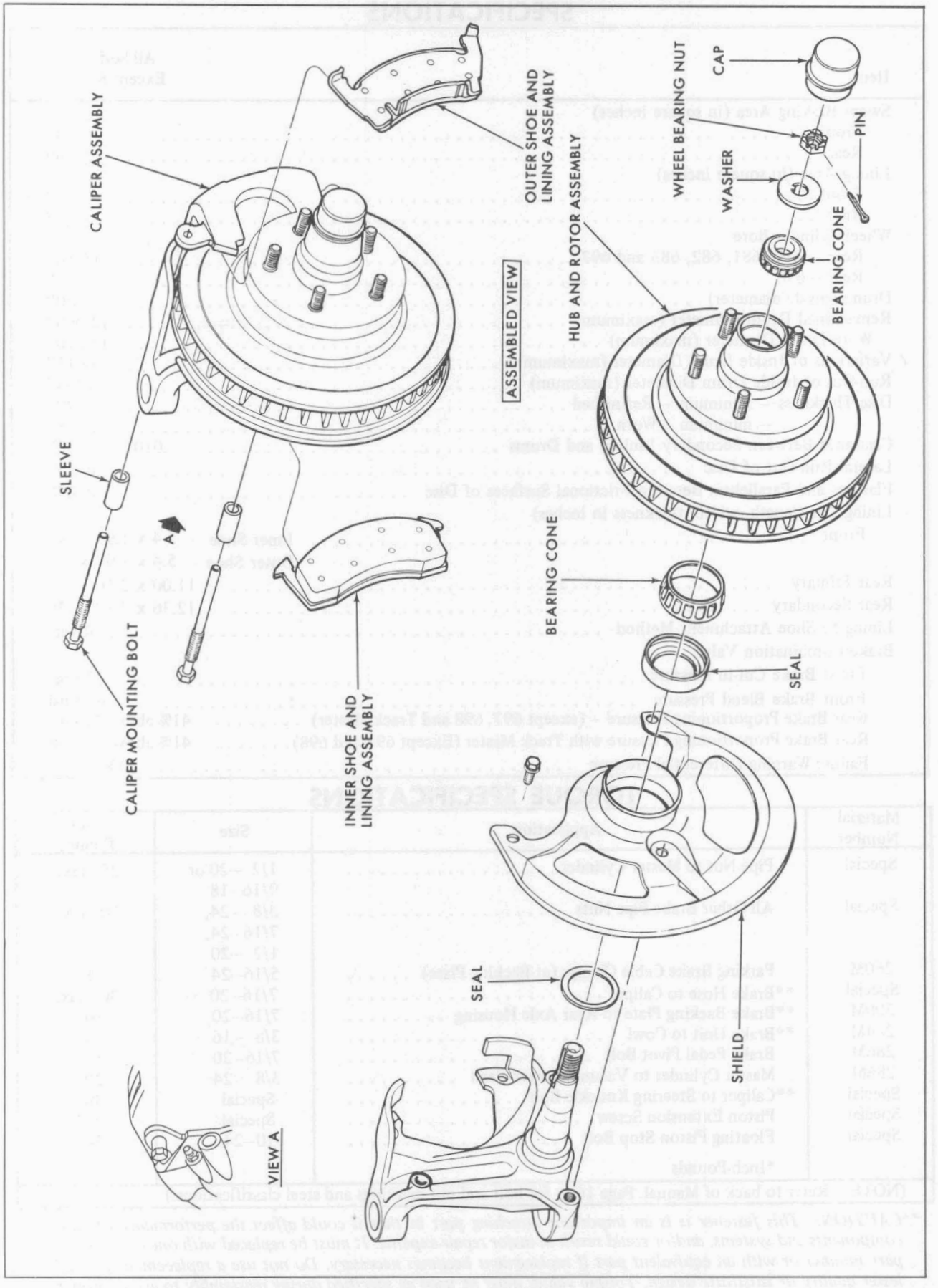


Fig. 5-44 Front Disc Brake

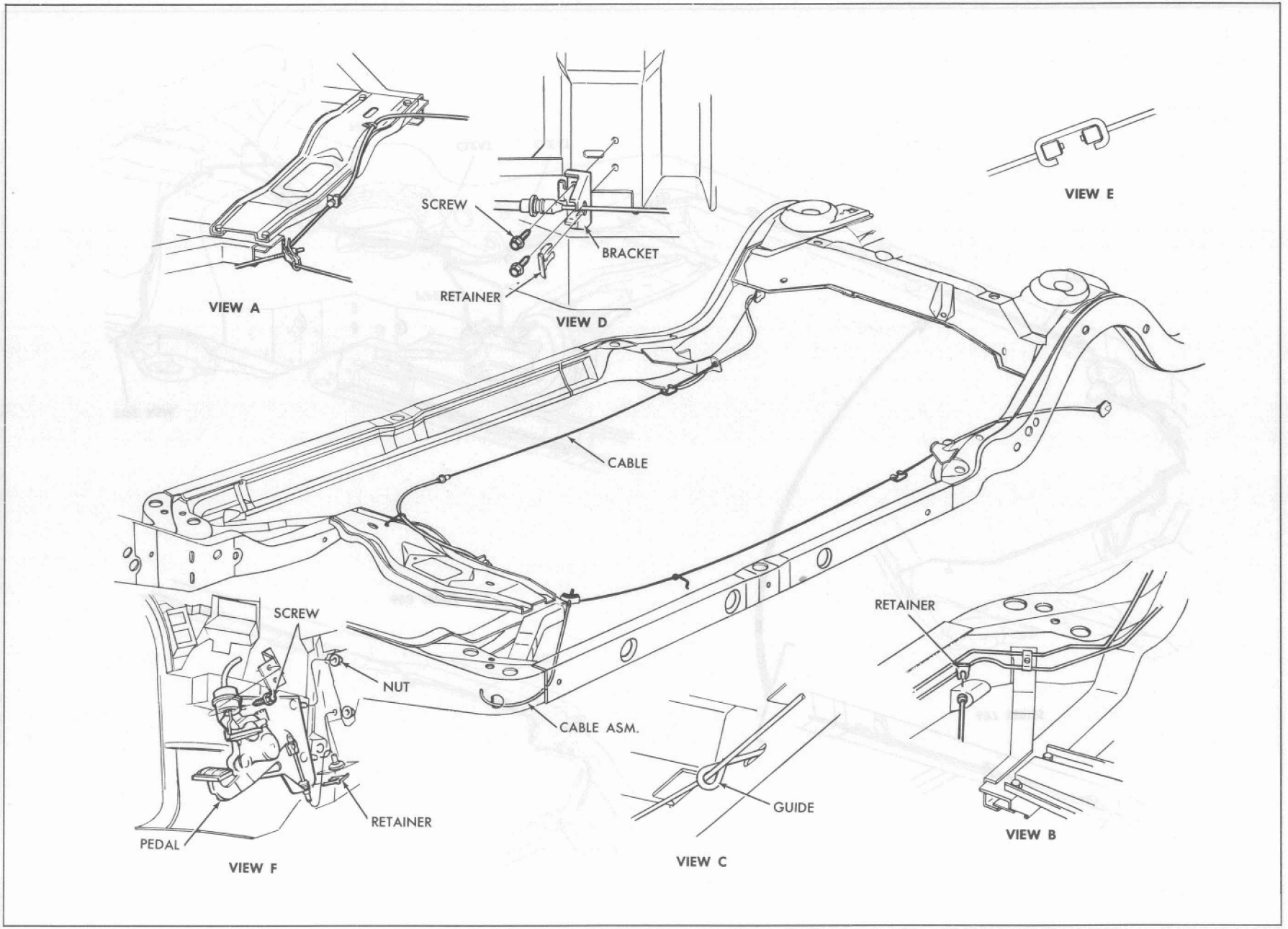


Fig. 5-45 Parking Brake

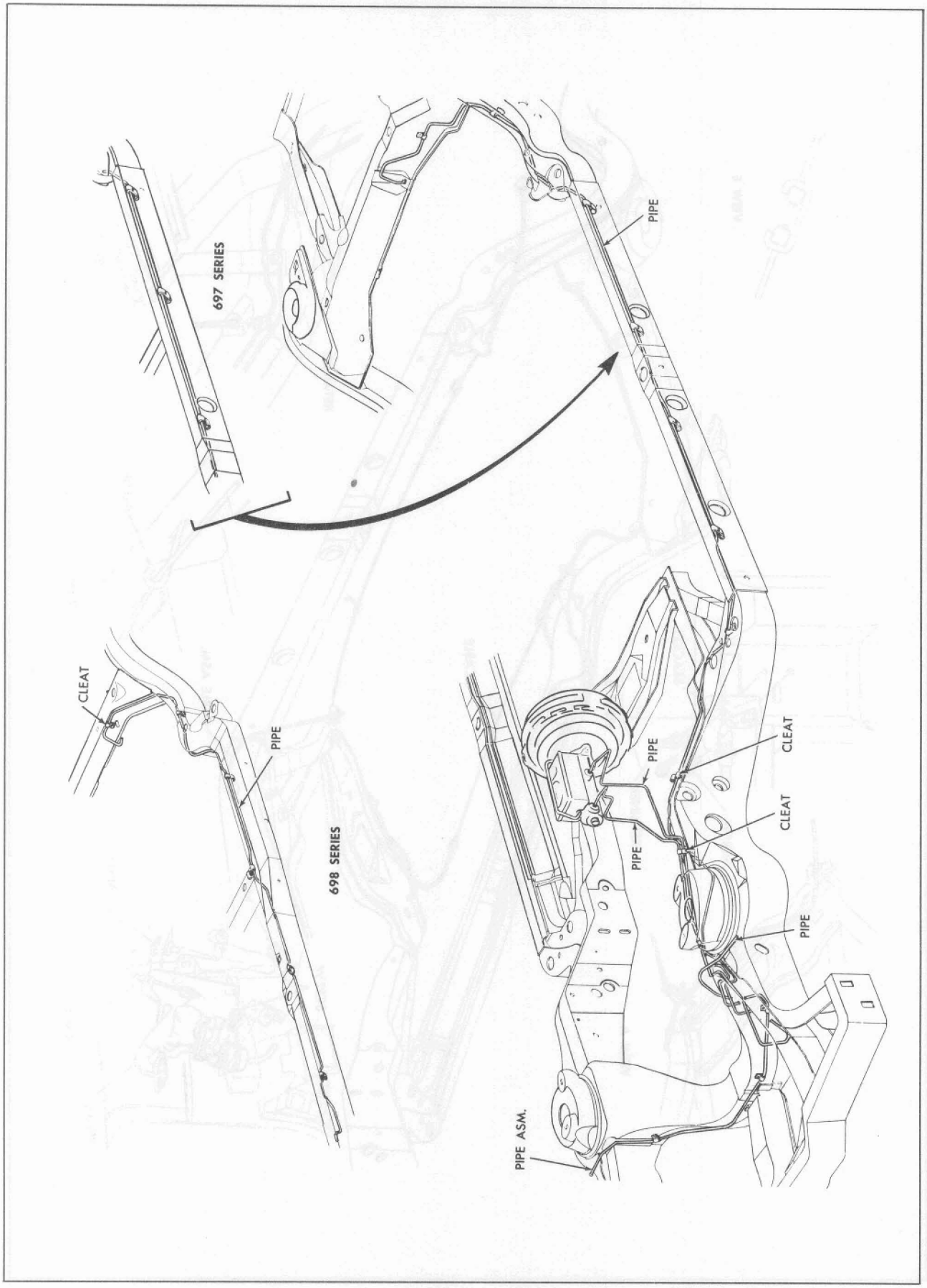


Fig. 5-46 Brake Lines—1

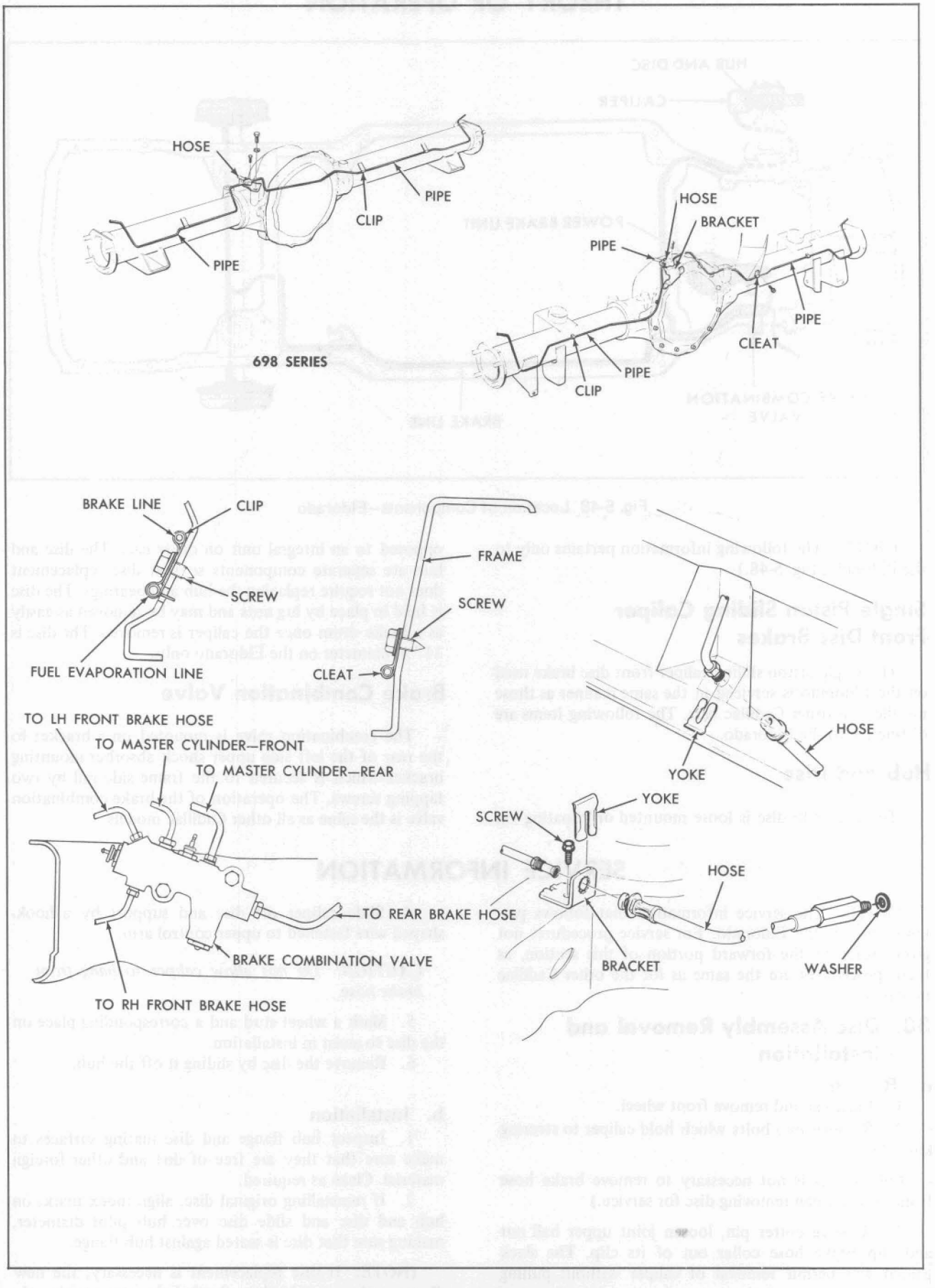


Fig. 5-47 Brake Lines—2

THEORY OF OPERATION

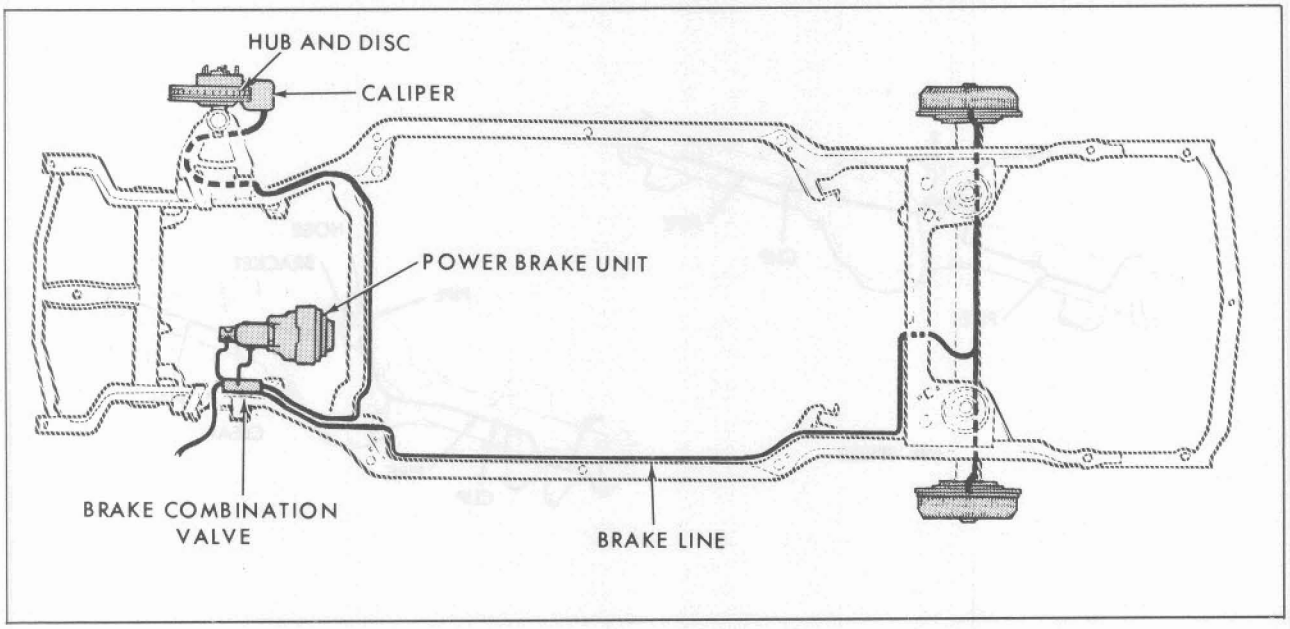


Fig. 5-48 Location of Components—Eldorado

(NOTE: The following information pertains only to the Eldorado, Fig. 5-48.)

Single Piston Sliding Caliper Front Disc Brakes

The single piston sliding caliper front disc brake used on the Eldorado is serviced in the same manner as those installed on other Cadillac cars. The following items are distinctive to the Eldorado.

Hub and Disc

The Eldorado disc is loose mounted or "floating" as opposed to an integral unit on other cars. The disc and hub are separate components so that disc replacement does not require replacing the hub and bearings. The disc is held in place by lug nuts and may be removed as easily as a brake drum once the caliper is removed. The disc is 11" in diameter on the Eldorado only.

Brake Combination Valve

The combination valve is mounted on a bracket to the rear of the left side upper shock absorber mounting bracket which is secured to the frame side rail by two tapping screws. The operation of the brake combination valve is the same as all other Cadillac models.

SERVICE INFORMATION

(NOTE: The service information that follows pertains only to the Eldorado. For service procedures not given, refer to the forward portion of this section, as these procedures are the same as for the other Cadillac models.)

30. Disc Assembly Removal and Installation

a. Removal

1. Raise car and remove front wheel.
2. Remove two bolts which hold caliper to steering knuckle.

(NOTE: It is not necessary to remove brake hose from caliper when removing disc for service.)

3. Remove cotter pin, loosen joint upper ball nut and slip brake hose collar out of its clip. The slack gained will permit removal of caliper without pulling hose.
4. Slide caliper off disc and support by a hook-shaped wire fastened to upper control arm.

CAUTION: Do not allow caliper to hang from brake hose.

5. Mark a wheel stud and a corresponding place on the disc to assist in installation.
6. Remove the disc by sliding it off the hub.

b. Installation

1. Inspect hub flange and disc mating surfaces to make sure that they are free of dirt and other foreign material. Clean as required.
2. If reinstalling original disc, align index marks on hub and disc and slide disc over hub pilot diameter, making sure that disc is seated against hub flange.

(NOTE: If disc replacement is necessary, the new disc may be assembled to the hub in any position. It

is not necessary to replace both discs if one is all right.)

3. Position caliper on disc and line up holes in caliper ears with holes in steering knuckle. Make sure brake hose is not twisted, as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.

4. Wipe all dirt and corrosion from the caliper mounting bolts. Do not use abrasives, as they will remove protective plating. Lubricate smaller ends of bolts with silicone lubricant.

5. Start either bolt into the inboard ear of the caliper and into the steering knuckle. At this point it is necessary to be sure that the bolt passes under the retaining ear on the inboard shoe to maintain the shoe in position in the caliper, Fig. 5-10.

6. Pass the bolt on through the outboard ear on the caliper until the threads on the bolt can be started into the steering knuckle.

7. Repeat steps 5 and 6 in placing remaining bolt into caliper assembly.

(See CAUTION page 5-8, prior to Note 6 for steps 8, 9, 10.)

8. Tighten caliper mounting bolts to 25-35 foot-pounds.

9. Center brake hose collar in clip and tighten ball joint nut to 60 foot-pounds. Install cotter pin.

10. Install wheels, tighten wheel mounting nuts to 105 foot-pounds and lower car.

11. Allow car weight to be supported on front wheels and inspect front brake hoses for twisted condition. If necessary, correct as described in Note 34b.

12. Before moving the vehicle, pump the brake pedal two or three times to insure firm pedal.

31. Relining Rear Drum Brakes (Fig. 5-49)

When brake relining is necessary, it is recommended that the complete brake lining and shoe assemblies be replaced with new assemblies. New lining and shoe assemblies are precision-ground to fit the drum diameter, minimizing the possibility of imperfect braking action due to warped brake shoes or partial contact between linings and drum. This simplifies the complete relining operation and insures a satisfactory job for the customer.

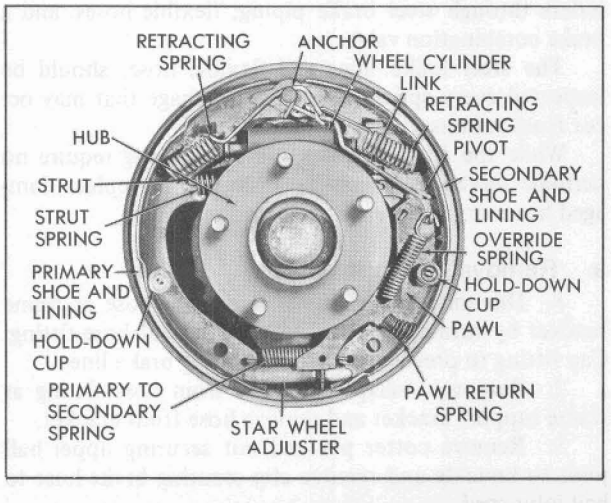


Fig. 5-49 Drum Brake Mechanism—693

Those Service Departments that have adequate brake shoe relining equipment may obtain linings, drilled and cut to size, from their servicing Parts Warehouses. Brake lining-grinding equipment should incorporate brake shoe holders that locate the shoes accurately in relation to the anchor end, as brake anchors are not adjustable and require accurately ground linings.

1. Release parking brake, raise car, and remove rear wheels and drums. A clip nut on one wheel stud retains the drum to the hub during removal.

CAUTION: When handling brake drums, be extremely careful not to drop the drum or get brake fluid or grease on frictional surface.

2. Loosen parking brake cable locknut at equalizer.

3. Remove primary brake shoe retracting spring, using Brake Spring Remover and Installer, J-8049.

4. Disconnect link at anchor, using Brake Spring Remover and Installer, J-8049, and remove link, secondary brake shoe retracting spring, and anchor plate.

5. Remove primary brake shoe hold-down cup, spring, washer and pin, secondary brake shoe hold-down cup, spring, pin and sleeve.

6. Remove pivot pawl and override spring as an assembly, and remove pawl return spring.

7. Spread brake shoes and remove parking brake strut rod and spring.

8. Remove parking brake operating lever from secondary brake shoe and remove shoe and lining assemblies from brake backing plate.

9. Remove star wheel adjuster and primary-to-secondary connecting spring from brake shoes.

10. Clean brake backing plate and all brake parts.

CAUTION: Make certain that hands are clean when handling brake parts. Avoid handling friction surfaces of drums and linings.

11. Torque nuts that hold backing plate to rear spindle to 30-40 foot-pounds torque.

(See CAUTION page 5-8 prior to Note 6.)

12. Lubricate threads and socket of star wheel adjuster and points of contact between brake shoes and other brake parts with special heat resistant lubricant, available from servicing Parts Warehouses. Use sparingly, especially on brake shoe pads.

13. Thread star wheel adjusting screw completely into pivot nut to permit installation of brake drum over replacement brake shoes.

14. Install star wheel adjuster and primary-to-secondary connecting spring on replacement brake shoes.

CAUTION: Star wheel adjusters with three wide groove on O.D. of pivot nut (left hand thread) are installed on right side of car, while those with three narrow groove (right hand thread) on O.D. of pivot nut are installed on left side of car.

15. Install parking brake operating lever on secondary brake shoe and position shoe and lining assemblies to brake backing plate.

16. Install parking brake strut rod and spring on brake shoes.

(NOTE: Spring is positioned against primary brake shoe with spring tab outside of brake shoe web.)

17. Engage brake shoes with wheel cylinder connecting links and install primary brake shoe hold-down pin, washer, spring (green) and cup.

18. Install anchor plate and position pivot, pawl and override spring as an assembly to secondary brake shoe.

19. Install link and pawl return spring and secure all parts to secondary brake shoe by installing hold-down sleeve.

20. Install secondary brake shoe hold-down pin, spring (maroon) and cup.

21. Install primary brake shoe retracting spring (grey) using Brake Spring Remover and Installer, J-8049.

22. Install secondary brake shoe retracting spring (blue) using Brake Spring Remover and Installer, J-8049.

23. Install rear brake drums and clip nut retaining drum to hub.

24. Perform manual service brake adjustment as described in Note 7.

25. Adjust parking brake as described in Note 8.

26. Install rear wheels and lower car.

32. Parking Brake (Fig. 5-50)

a. Front Cable

The procedure for removing and installing the front parking brake cable is described in Note 22a and 22b respectively.

b. Removal—Center Cable

1. Release parking brake.
2. Remove equalizer nut and washer from cable stud and remove equalizer.
3. Remove cable from wire guide at center of cross member.
4. Remove cable from wire guide at right side frame side rail.
5. Remove cable from right and left connectors to rear cables.
6. Thread cable out of cross member and through body bracket. Remove cable.

c. Installation—Center Cable

1. Thread cable through body bracket and cross member.
2. Install cable in right and left connectors.
3. Install cable in wire guide at right frame side rail.
4. Install cable in wire guide at center of cross member.
5. Install equlaizer on cable stud and secure with washer and nut.
6. Check operation of parking brake and adjust as described in Note 8.

d. Removal—Rear Cable

1. Release parking brake.
2. Raise rear of car and position on jack stands.
3. Remove rear wheels and drums.
4. Loosen equalizer nut and washer.
5. Remove cable from connector.
6. Remove U-shaped clips retaining parking brake cable to lower control arm brackets on right and left sides.
7. Remove cable ends from parking brake operating levers, and remove cable ends from backing plates.

e. Installation—Rear Cable

1. Install cable ends through backing plates and connect to parking brake operating levers.
2. Install pawl lever and pawl spring.

CAUTION: Pull on cable and check operation of cable and brake mechanisms.

3. Position brake cable to lower control arm brackets on right and left sides of car, and secure with clip.
4. Install cable in connector.
5. Tighten equalizer nut and washer.
6. Install rear drums and wheels.
7. Adjust parking brake as described in Note 8.

33. Brake Combination Valve

a. Removal

1. Raise hood.
2. Disconnect wiring connector from valve.
3. Disconnect three brake pipes from top and one from front of valve and remaining brake pipe from bottom of valve.
4. Remove two bolts securing valve to frame bracket and remove valve.

b. Installation

1. Position valve to frame bracket and secure with two bolts.
2. Install brake pipe to bottom of valve and one brake pipe to front of valve and three on top.
3. Connect wiring connector to valve.
4. Bleed brakes as described in Note 6.
5. Close hood.

34. Servicing Hydraulic Brake Hoses and Piping (Fig. 5-51)

Hydraulic pressure is transferred to the wheel cylinders through steel brake piping, flexible hoses, and a brake combination valve.

The steel brake lines and flexible hoses should be inspected every spring and fall for damage that may occur from various road hazards.

While the flexible hoses and steel piping require no periodic servicing, it may be necessary to replace damaged hoses or piping in the following manner:

a. Removal—(Front Wheels)

1. Disconnect steel brake line from hose at frame bracket by turning steel tube fitting out of hose fitting. Cap fitting to prevent dirt from entering brake line.
2. Remove U-shaped retainer from hose fitting at frame support bracket and remove hose from bracket.
3. Remove cotter pin and nut securing upper ball joint to knuckle and remove clip securing brake hose to ball joint stud.

4. If right front hose is being replaced, remove clip retaining hose to frame.

5. Turn hose out of inlet fitting of caliper and remove and discard copper gasket. If hose is to be reused, cap end fittings to prevent dirt from entering hose.

b. Installation–(Front Wheels)

1. Install new copper gasket on caliper end of hose (male end).

2. Tighten hose in caliper inlet to 30 foot-pounds maximum torque.

CAUTION: Never tighten hose in wheel cylinder inlet with hose attached at frame end, as this will twist the hose.

3. Install brake hose clip on upper ball joint stud and install ball joint retaining nut on stud. Tighten ball joint nut finger tight.

4. With suspension in normal position (front wheels straight ahead and front suspension at normal standing height) pass female end of hose through frame support bracket, allowing hose to seek its own position. Insert hex of hose fitting into the 12-point hole in support bracket in the position that will result in least twisting of hose.

(NOTE: Do not twist hose any more than necessary during this operation as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension, steering and driving parts.)

5. Install U-shaped retainer to secure hose to frame support bracket.

6. If right front hose is being replaced, install clip securing hose to frame.

7. Inspect by turning wheels from stop-to-stop while observing hose position. Be sure that hose does not touch any other part at any time during steering travel. If contact does occur, remove hose retainer, and if necessary loosen upper ball joint nut, and reposition hose as necessary. Replace retainer, tighten ball joint nut finger tight, and reinspect.

8. When hose is properly positioned, torque ball joint nut to 60 foot-pounds minimum.

(See CAUTION page 5-8 prior to Note 6.)

(NOTE: If cotter pin cannot be installed, tighten nut to next hole and install cotter pin.)

CAUTION: When installing cotter pin, make sure ends of pin are pinched tight against flat of nut. DO NOT let end of cotter pin extend down toward outer drive axle seal.

9. Install steel brake line fitting into brake hose at frame support bracket and tighten fitting to 20 foot-pounds maximum torque.

10. Bleed brakes as described in Note 6.

c. Removal–Hydraulic Brake Piping (Rear Wheels)

1. Disconnect steel brake piping at rear wheel cylinder fitting. Cap fitting to prevent dirt from entering wheel cylinder.

2. Disconnect brake piping at brake line junction fitting on rear axle.

3. If left brake pipe is being removed, bend clip open and remove pipe.

4. If right brake piping is being removed, bend clips open and remove piping.

d. Installation–Hydraulic Brake Piping (Rear Wheels)

1. Position brake piping to rear axle and hand start tube nuts into wheel cylinder and junction block.

a. If right brake piping is being installed, bend clips over pipe, retaining piping to rear axle.

b. If left brake piping is being installed, bend clip retaining piping to rear axle.

2. Tighten piping to brake line junction fitting on rear axle, tighten to 20 foot-pounds maximum torque.

3. Tighten brake piping to rear wheel cylinder fitting, tighten to 20 foot-pounds maximum torque.

4. Bleed all brakes as described in Note 6.

e. Removal–Hydraulic Brake Hose (Rear Wheels)

1. Disconnect steel brake pipe from hose. Cap pipe.

2. Remove retainer securing forward end of brake hose to frame.

3. Remove bolt from junction block on axle.

4. Disconnect rear axle piping from junction block. Cap pipes.

f. Installation–Hydraulic Brake Hose (Rear Wheels)

1. Connect rear axle piping to junction block. Tighten fittings to 20 foot-pounds maximum torque.

2. Bolt junction block to axle.

3. Pass female end of hose through frame allowing hose to seek its own position.

4. Install retainer to secure hose to frame.

5. Place steel tube connector in hose fitting and tighten to 20 foot-pounds maximum torque.

CAUTION: Do not allow hose to twist out of its normal position.

6. Bleed all brakes as described in Note 6.

TORQUE SPECIFICATIONS—ELDORADO ONLY

Material Number	Application	Size	Foot-Pounds
280M	Bearing Retainer/Splash Shield to Knuckle	3/8-16	30
286M	**Brake Backing Plate to Rear Axle Housing	3/8-24	35
	For other Torque Specifications Refer to Page 5-31		
(NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings and steel classifications.)			

***CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

SPECIFICATIONS

Item	693 Series Cars
Swept Braking Area (in square inches)	
Front	224
Rear	138
Lining Area (in square inches)	
Front	41.76
Rear	84
Wheel Cylinder Bore	
Front	2-15/16"
Rear	15/16"
Drums (inside diameter)	11.00"
Remachined Drum Diameter (maximum)	11.06"
Worn Drum Diameter (maximum)	11.09"
Variations of Inside Drum Diameter (maximum)	.002"
Run-Out of Inside Drum Diameter	.005"
Lateral Run-Out of Disc on Hub (Maximum)	.008"
Flatness and Parallelism Between Frictional Surfaces of Disc	.0005"
Minimum Disc Thickness	1.190"
Lining Size (length, width, thickness in inches)	
Front	Inner Shoe 5.4 x 1.93 x .43
	Outer Shoe 5.4 x 1.93 x .41
Rear	
Primary	9.00 x 2.00 x .20
Secondary	12.00 x 2.00 x .29
Lining to Shoe Attachment Method	Rivets
Brake Combination Valve	
Front Brake Cut-in Pressure	130 psi
Front Brake Blend Pressure	650 psi
Rear Brake Proportioning Pressure Except with Track Master	41% above 350 psi
Rear Brake Proportioning Pressure with Track Master	41% above 470 psi
Failure Warning Differential Pressure	100-300 psi

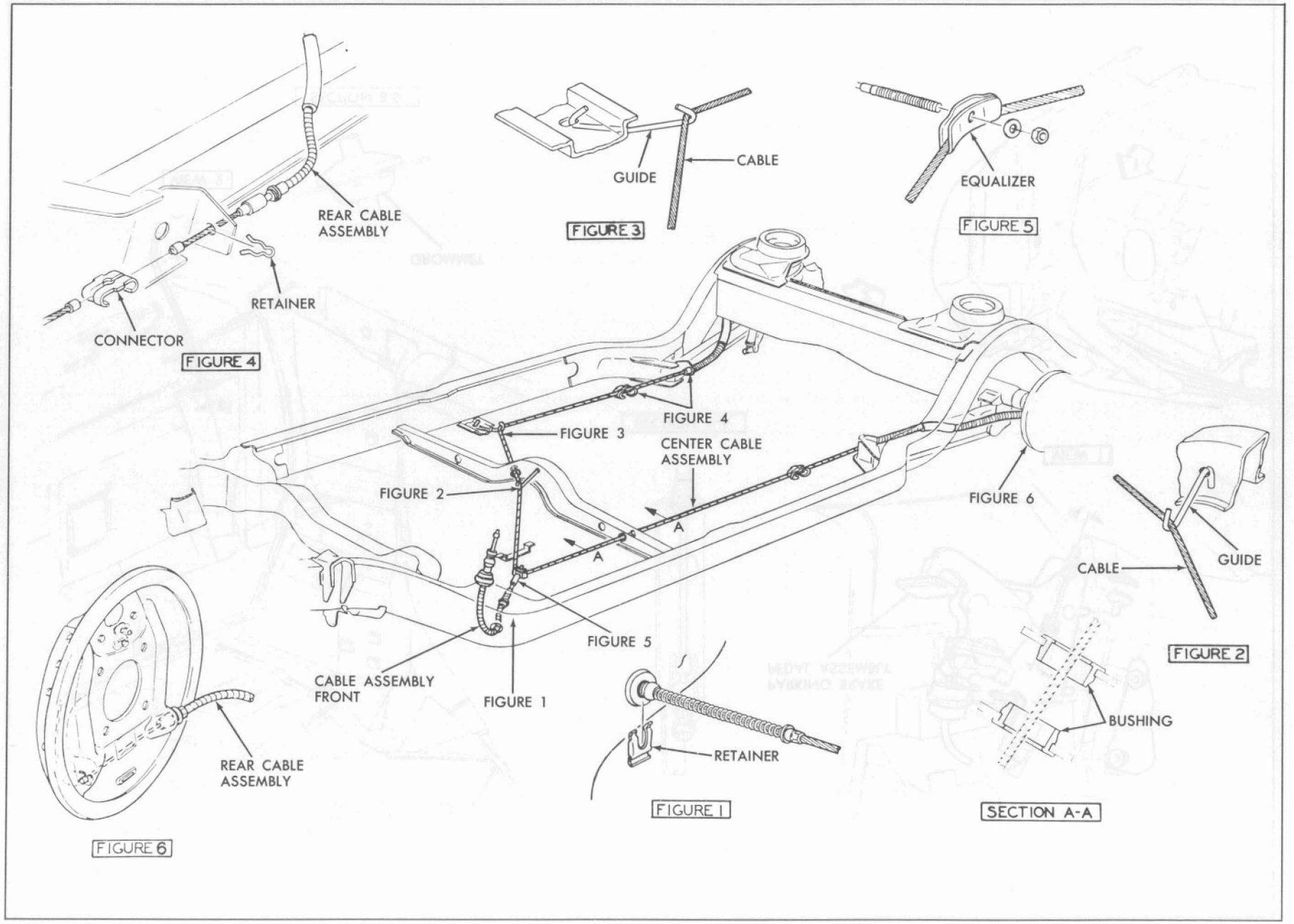


Fig. 5-50 Eldorado Parking Brake—1

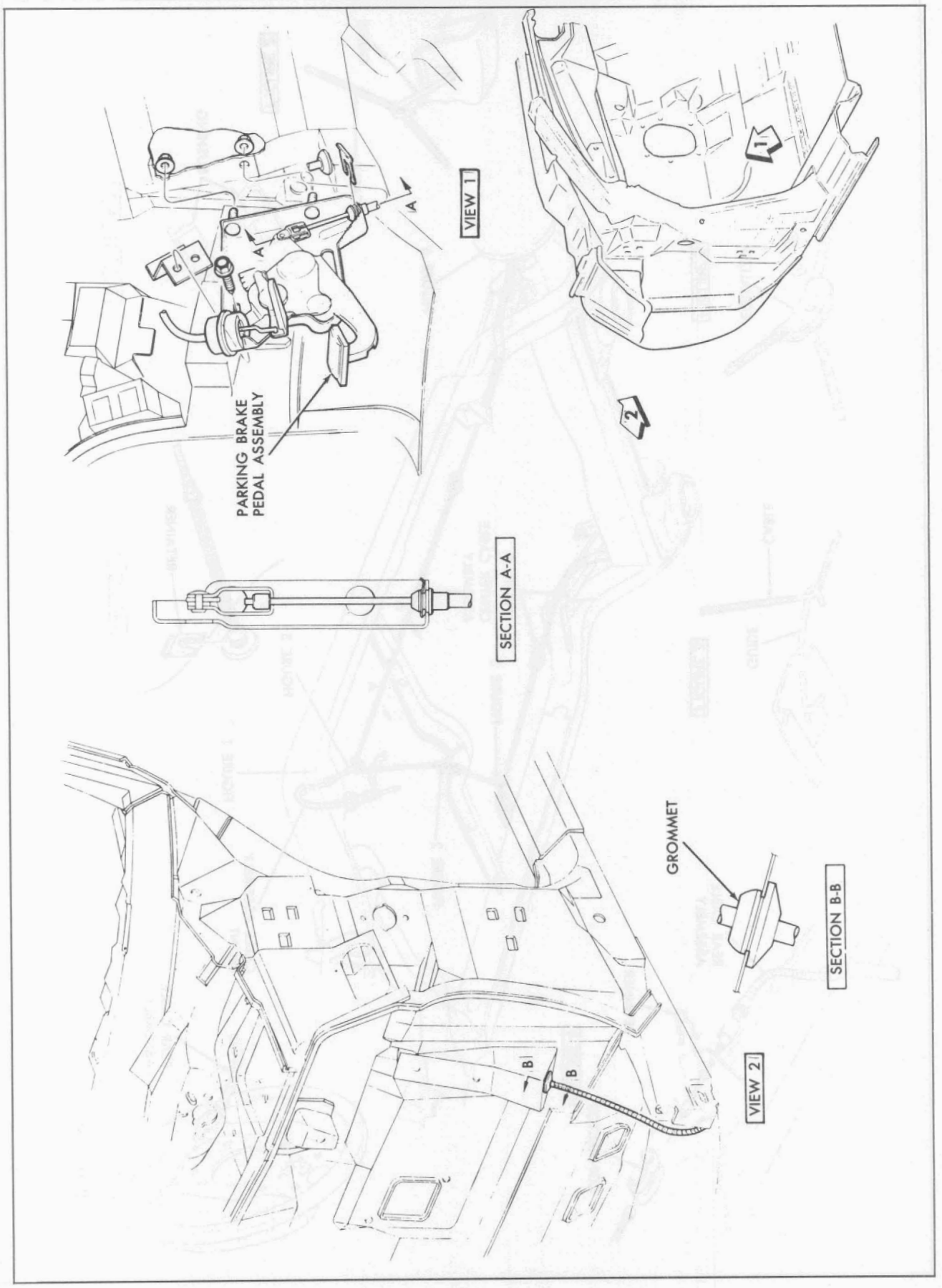


Fig. 5-51 Eldorado Parking Brake–2

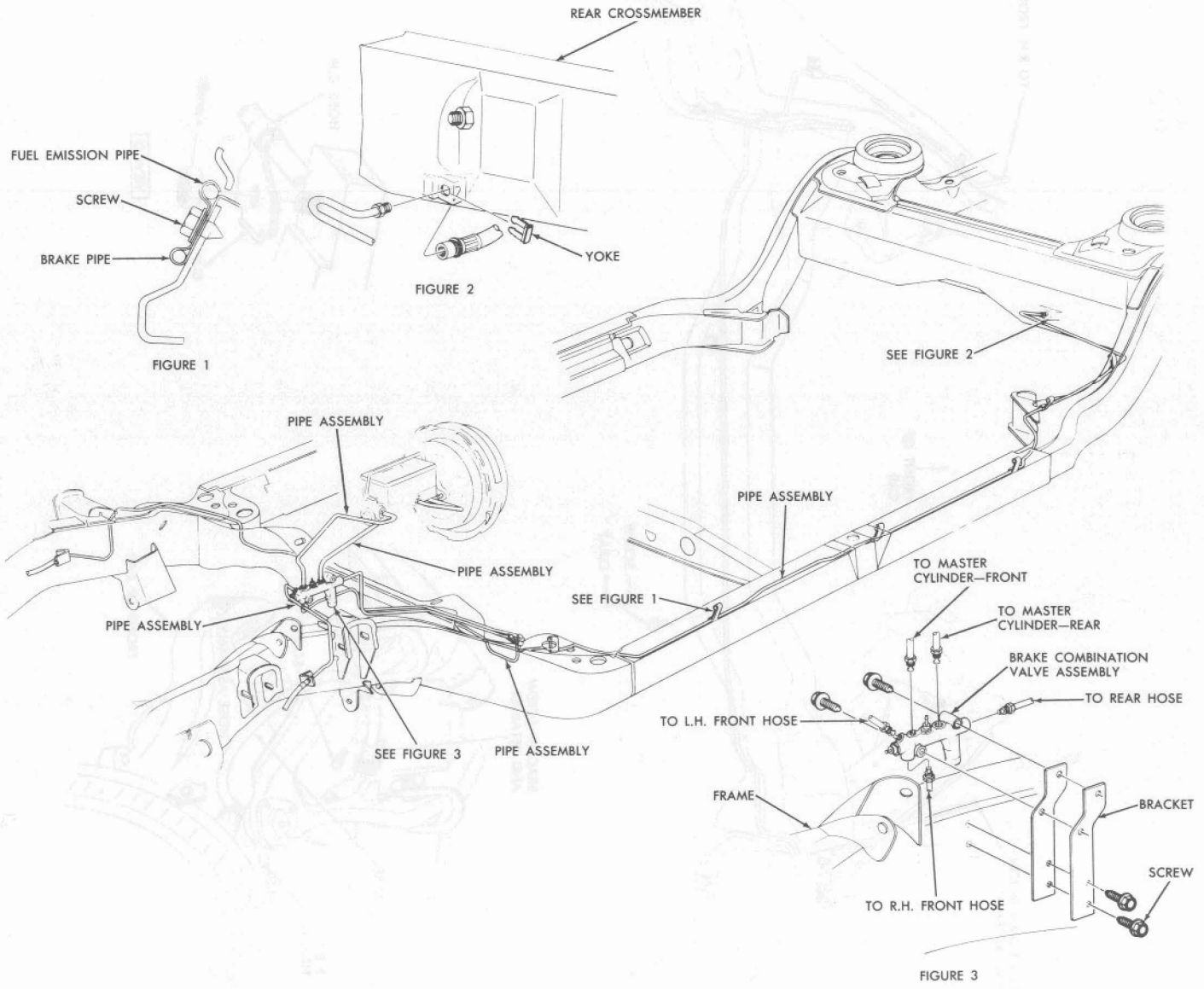


Fig. 5-52 Eldorado Brake Lines—1

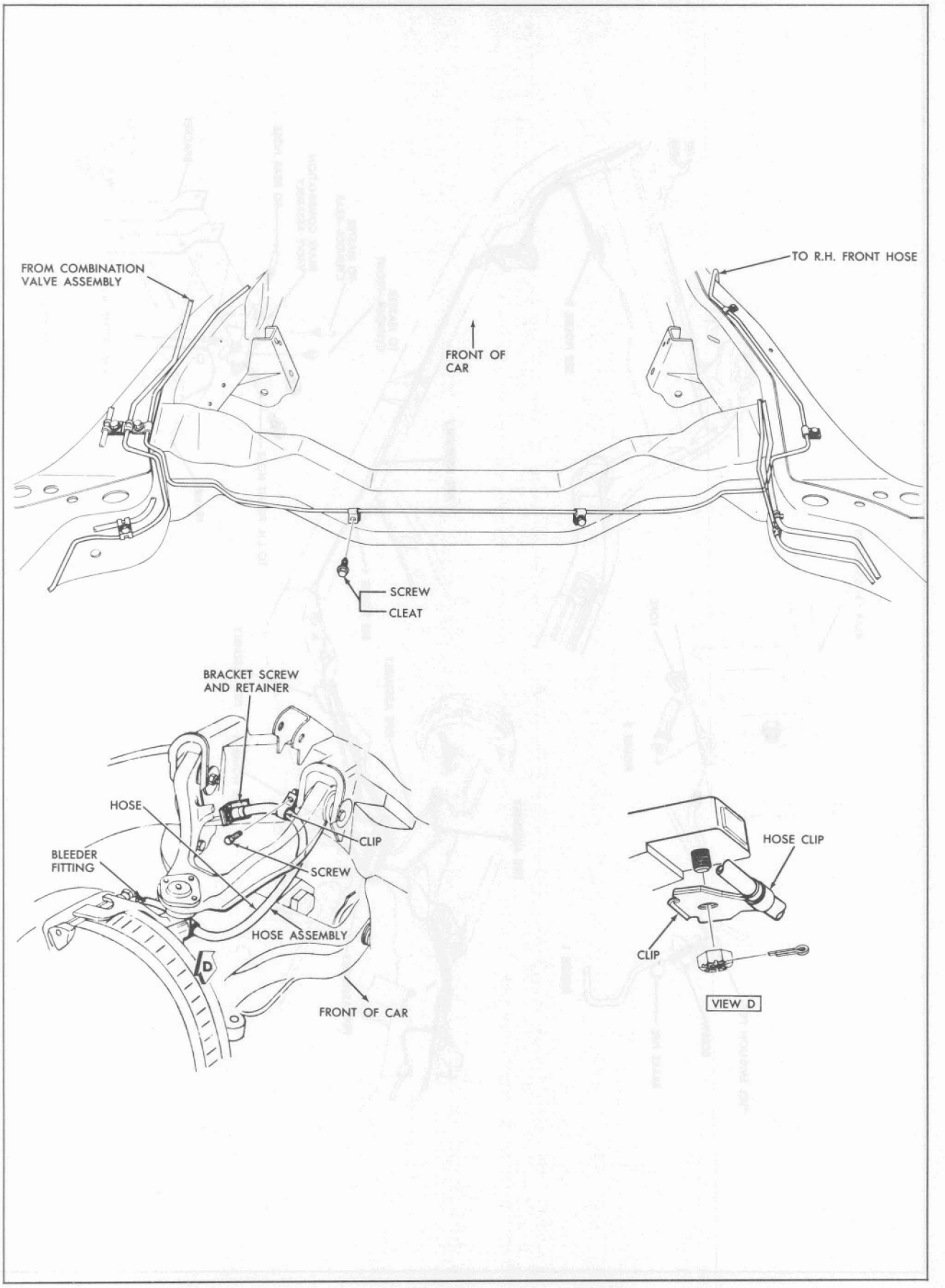


Fig. 5-53 Eldorado Brake Lines–2

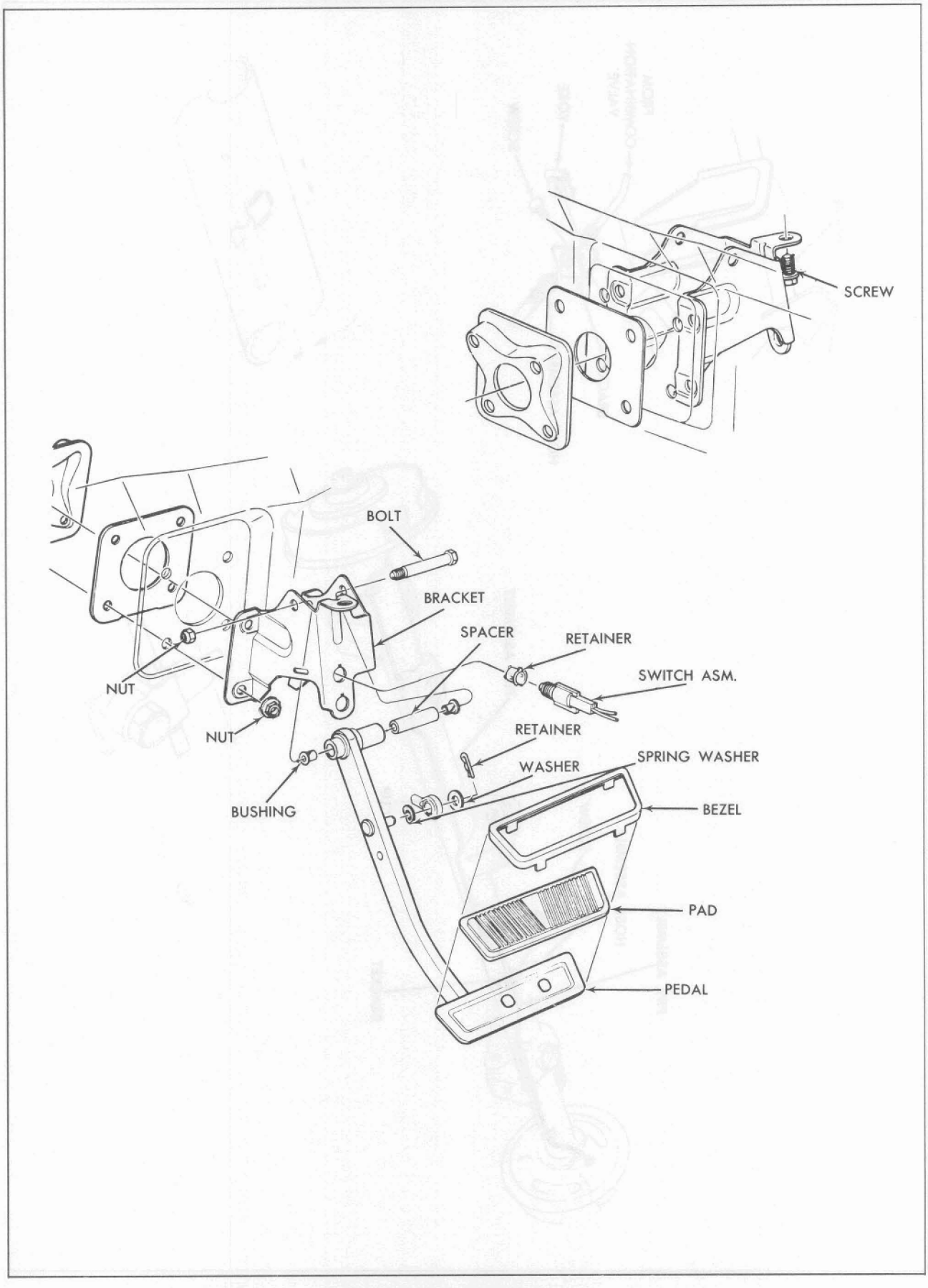


Fig. 5-54 Eldorado Brake Lines–3

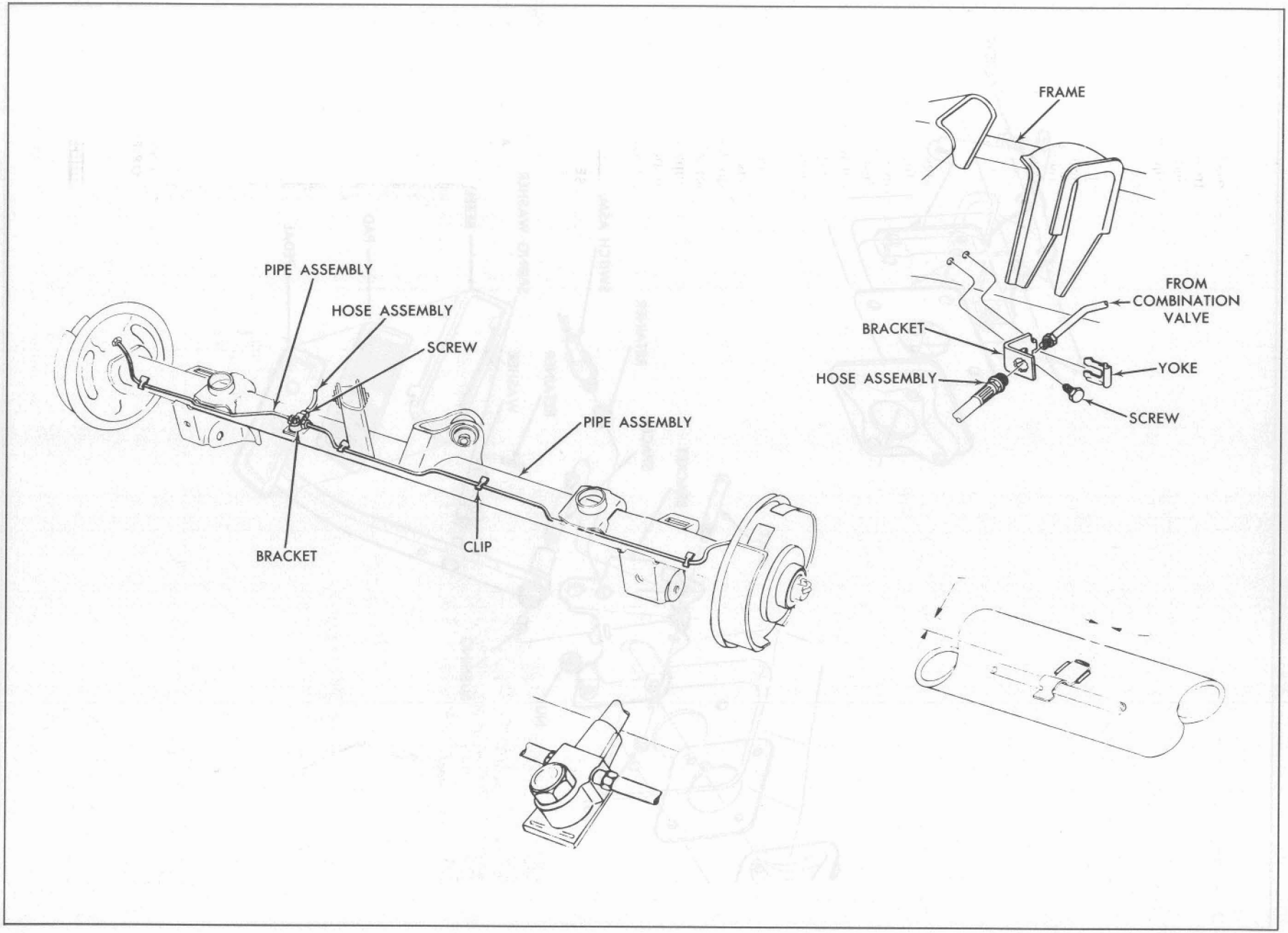


Fig. 5-55 Eldorado Brake Lines—4

THEORY OF OPERATION

Purpose of System

Wheel or brake lock-up occurs when the brake is applied so tightly that the wheel is held from turning and skids on the road surface. Since a tire will skid about as easily in one direction as another, a car with locked rear wheels may yaw or swerve, sending the rear end out of control. In severe cases this yaw may result in "spin-out"

Skidding may also increase the distance in which the car may be stopped as friction developed between tire and road surface may be less when sliding than when rolling, especially on a wet surface.

To reduce these undesirable braking characteristics, the Track Master System is available as optional equipment. The primary purposes of the system during a panic stop or other hard application of brakes are: (1) maintain lateral stability of the car; (2) provide near maximum controlled braking effort to decrease stopping distance, on most road surfaces; (3) prevent flat spots on tires.

Controlling Rear Wheel Lock

All of these objectives are obtained by keeping the rear wheels rolling, with the brakes applied as tightly as possible, without actually locking the rear wheels. In practice, improvement in lateral stability is significant under most driving conditions, while decrease in stopping distance is most effective on wet pavements.

Friction between tire and road will vary widely according to type of tire and its tread condition as well as type of road and its surface condition. These variables make it impossible to predetermine the correct amount of friction and hydraulic pressure to stop without locking the rear wheels.

Instead, this friction must be established automatically in each instance of brake application at the maximum possible, while still allowing the rear wheels to turn. This determination is made by the system sensing when the wheels are beginning to lock.

Basic Operation

Most car stops are at low rates of deceleration, with only a moderate application of force to the brakes, and the Track Master System is passive. However, the system is energized whenever the ignition is on, and it stands ready to function whenever a rear wheel is about to lock — whether as a result of an emergency stop with good tires on dry concrete or just a slow stop with bald tires on a wet or icy road.

The Track Master System is composed of the following major components: C-car has a speed sensor at the transmission while the Eldorado has speed sensors at each rear wheel; controller under instrument panel; and modulator on cowl in engine compartment.

Skid control starts with a speed indication taken from a magnetic pick-up device known as the sensor.

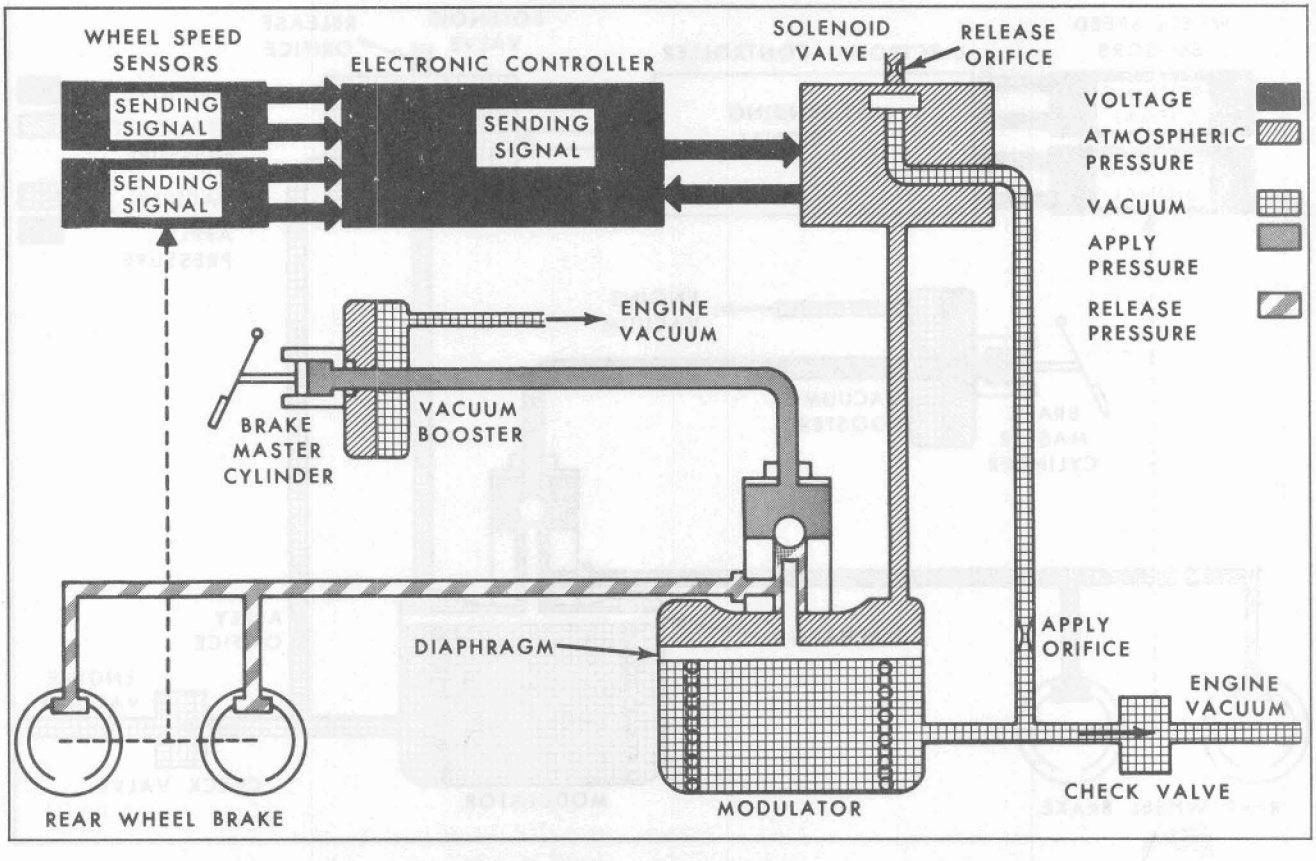


Fig. 5-56 Pictorial View—Normal Braking—Eldorado

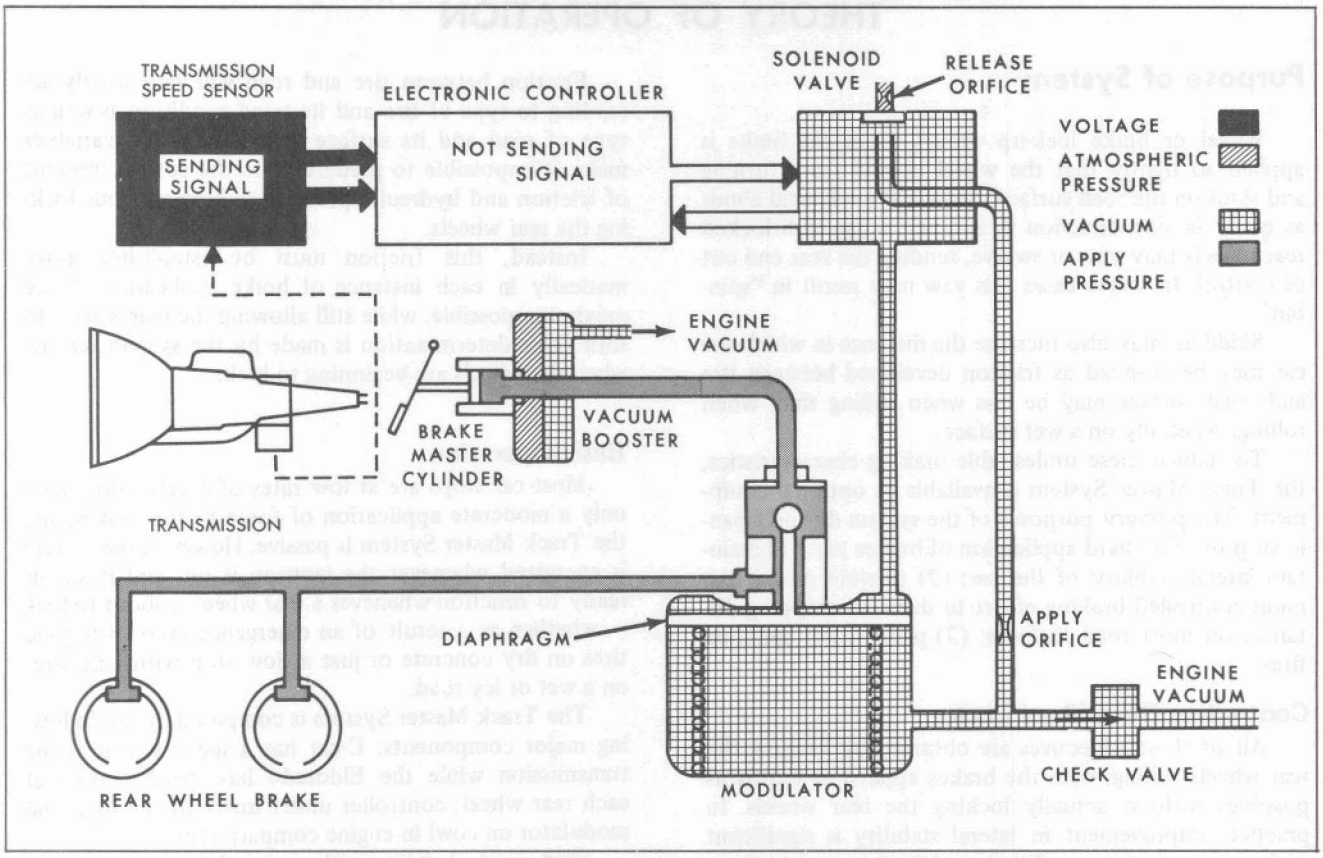


Fig. 5-57 Pictorial View–Normal Braking–Exc. Eldorado

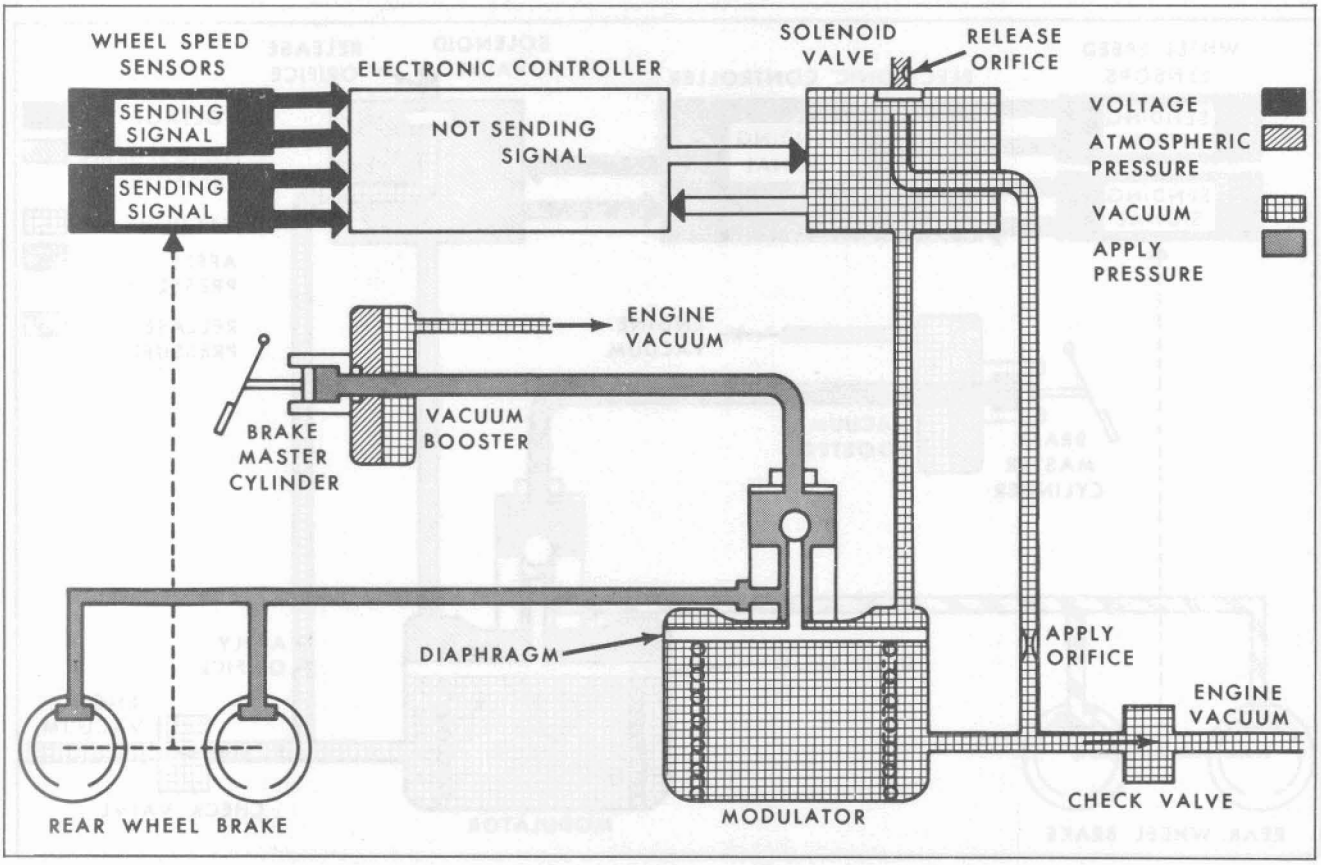


Fig. 5-58 Pictorial View–Release Mode–Eldorado

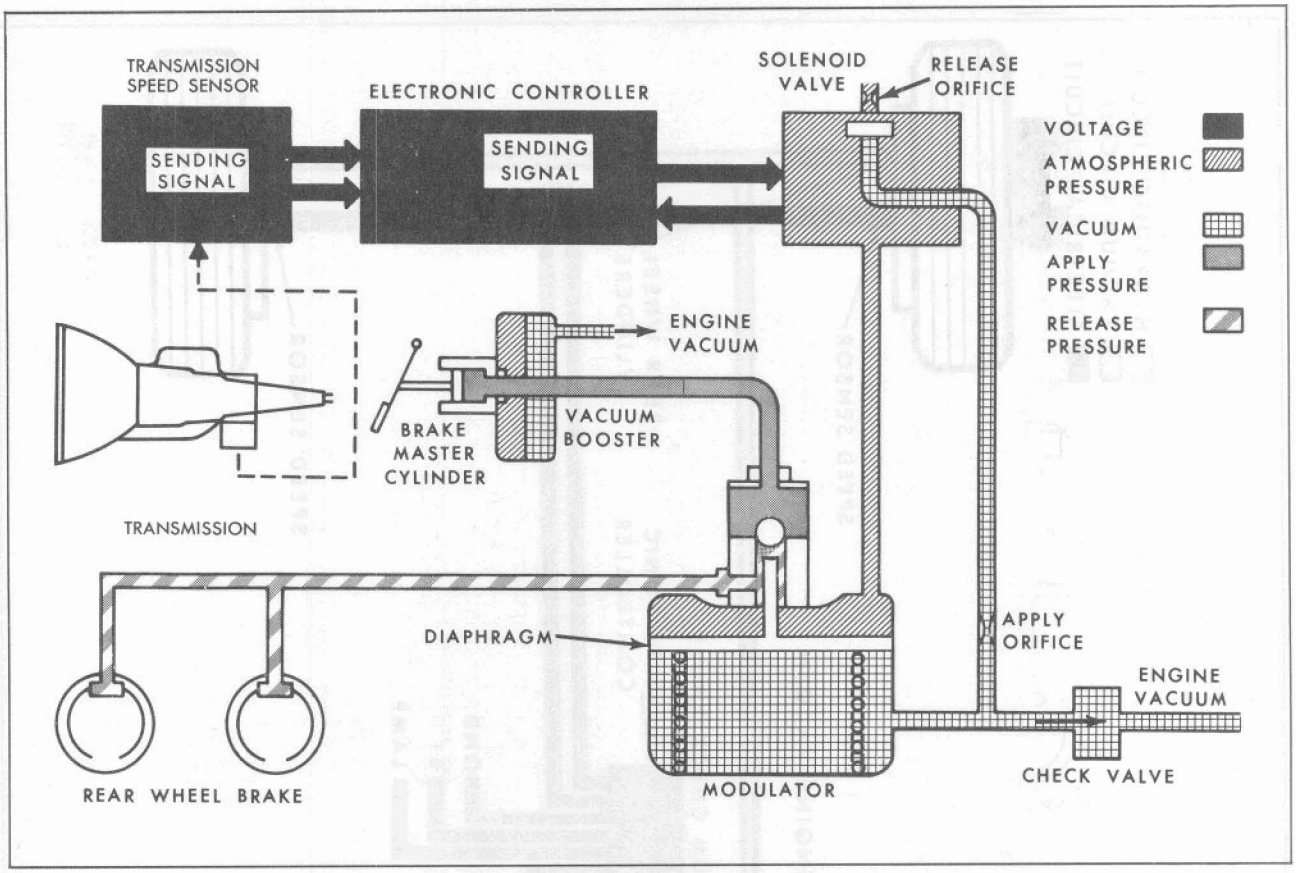


Fig. 5-59 Pictorial View–Release Mode–Exc. Eldorado

The sensor produces an electrical frequency that is proportional to wheel speed. This frequency is monitored by the controller.

When a wheel is not locking during brake application, the wheel will gradually decelerate. However, when a wheel has started to lock, it will decelerate abruptly at a rate much faster than the car's deceleration.

When the controller determines that the frequency changes too rapidly and the car is thereby approaching a skid condition, the controller sends an electrical signal to the modulator solenoid.

The modulator seals hydraulic pressure from the brake master cylinder and then increases the volume from the modulator to the rear wheel cylinders. This increased volume results in decreased hydraulic pressure and partial brake release.

With the rear brakes partially released, the wheels accelerate and, as car speed is approached, the controller senses the condition and de-energizes the modulator.

This action positions the modulator to increase brake pressure to the rear wheel cylinders until a locking condition is again sensed. The entire cycle of partial brake release and re-application occurs in about 1/3 of a second. During a stop where brake pressure is sufficient to cause lock-up, the cycling will continue until the car is slowed to approximately five miles per hour, or until the brakes are released by the driver.

Figures 5-56, 5-57, 5-58 and 5-59 are pictorial diagrams of the system in the normal braking and released mode, respectively.

Control Circuits

Figure 5-60 and 5-61 illustrate the total Track Master System control circuits.

a. Hydraulic Control Circuit

In addition to the normal brake system components (dual master cylinder, brake combination valve, front wheel cylinders, rear wheel cylinders, connecting brake lines), the hydraulic control circuit also includes the hydraulic check valve. This valve, which is an integral part of the modulator assembly, is connected between the brake combination valve and rear brake wheel cylinders.

b. Vacuum Control Circuit

This vacuum control circuit includes the vacuum hose connection from the engine manifold, vacuum check valve, valve section of the solenoid valve, and actuator section of the modulator assembly. The vacuum control circuit provides the power necessary to operate the modulator.

c. Electrical Control Circuit

This electrical control circuit includes the controller, solenoid section of the solenoid valve, speed sensor and modulator travel switch. Electrical power is supplied to the Track Master System when the ignition switch is turned to all positions except "OFF" and "Accessory".

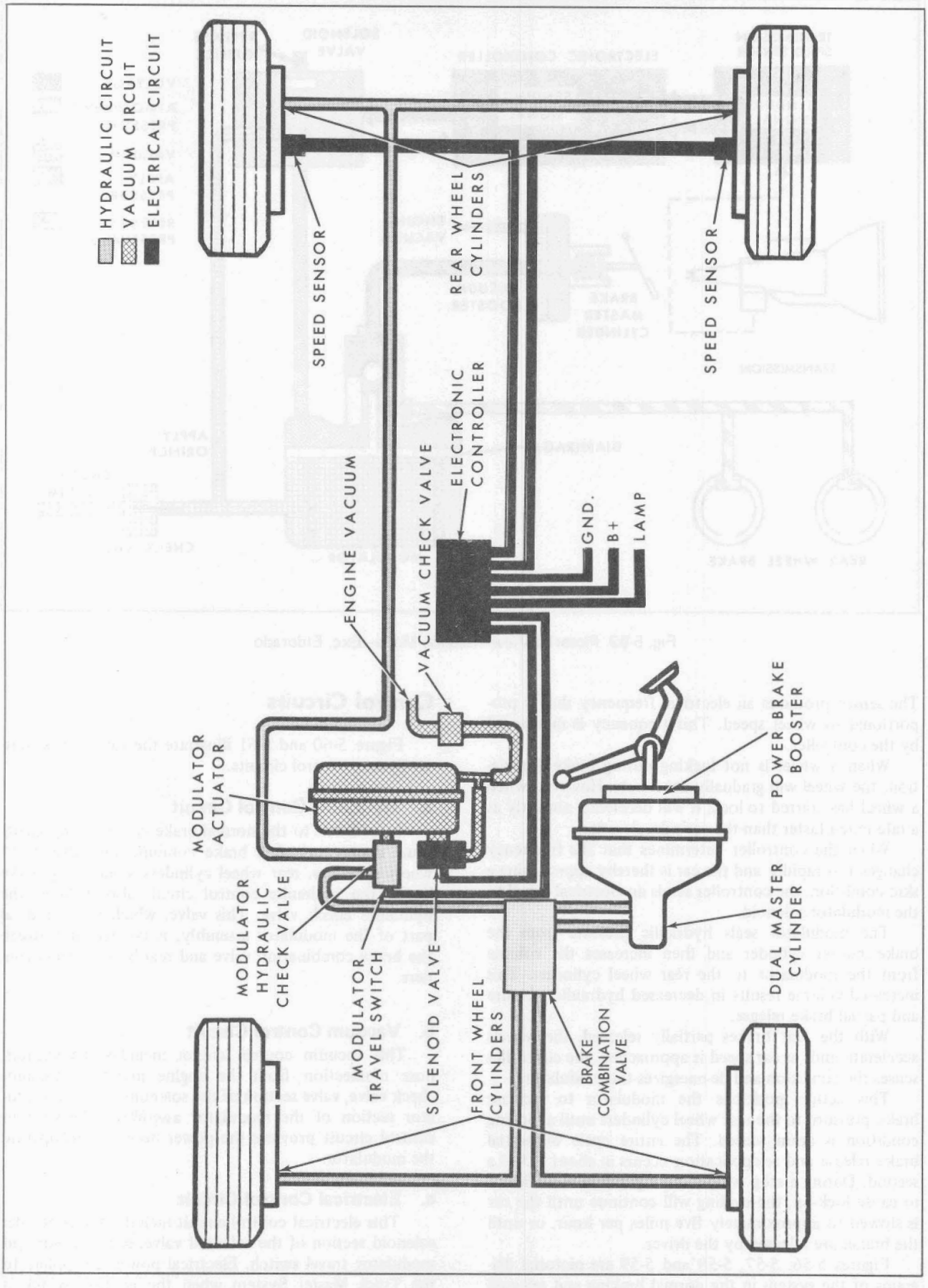


Fig. 5-60 Control Circuits—Eldorado

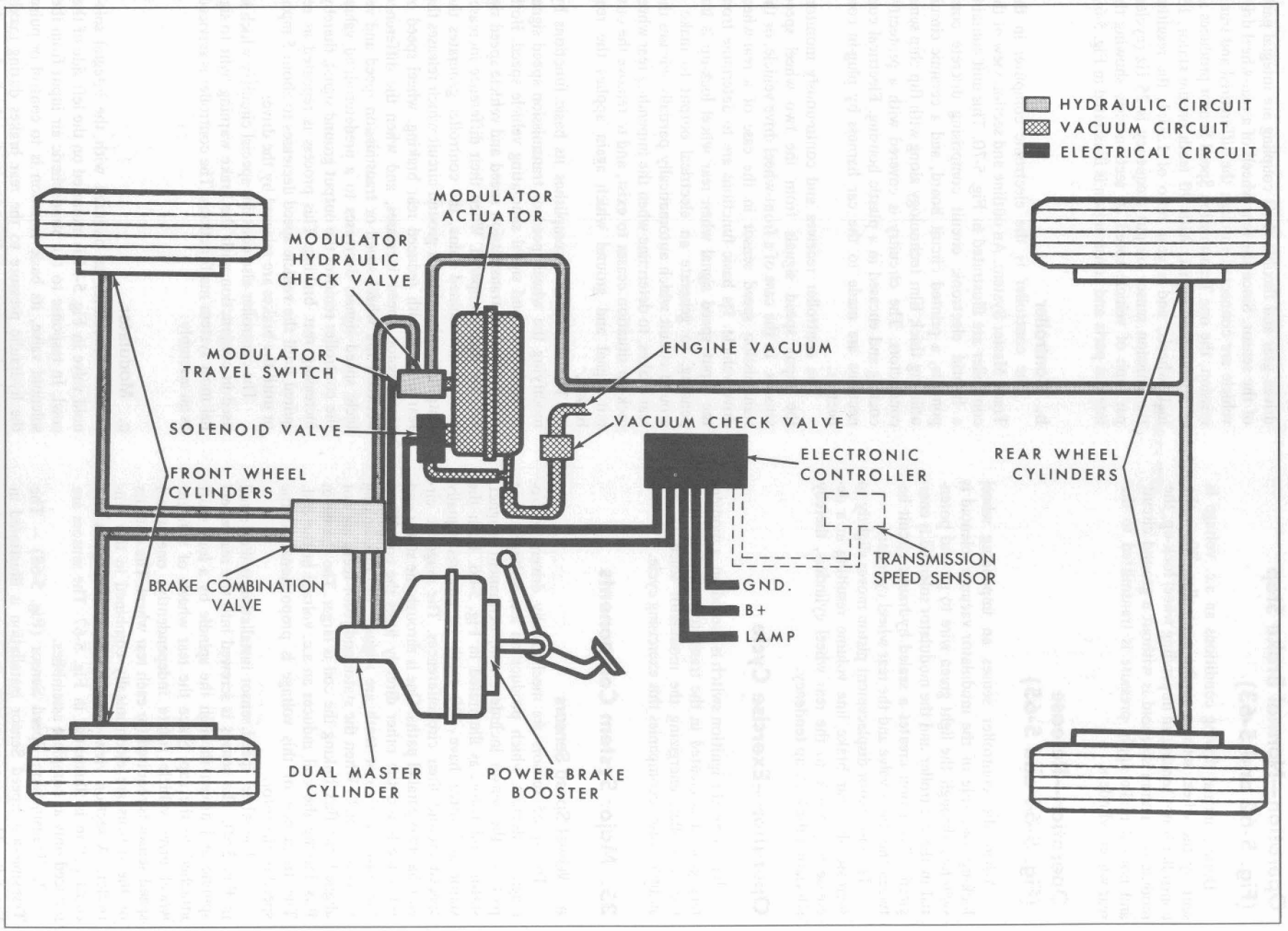


Fig. 5-61 Control Circuits—Exc. Eldorado

Operation—Normal Brake Stop (Fig. 5-62 and 5-63)

During normal driving conditions an a.c. voltage is sent by the wheel sensors to the controller. When the controller is not sensing an impending wheel lock-up, the modulator vacuum solenoid is without a ground circuit and normal brake apply pressure is transmitted to the rear wheel cylinders.

Operation—Release (Fig. 5-64 and 5-65)

When the controller senses an impending wheel lock-up, one side of the modulator vacuum solenoid is switched through the light green wire to ground potential in the controller and the modulator solenoid is energized. This action creates a sealed hydraulic circuit between the check valve and the rear wheel cylinders.

The modulator displacement piston moves slightly to increase the rear brake line volume resulting in a decrease in pressure to the rear wheel cylinders, thereby alleviating the lock-up tendency.

Operation—Exercise Cycle

Each time the ignition switch is turned on, a momentary ground is created in the transistorized circuitry of the controller, energizing the modulator solenoid. An audible noise accompanies this exercising cycle.

35. Major System Components

a. Wheel Speed Sensors

The speed sensors are mechanically driven electromagnetic devices which produce an a.c. voltage. Basic parts of the sensor include a coil, permanent magnet, stator, and rotor, as illustrated in Fig. 5-66. Both the stator and rotor have 120 teeth or grooves equally spaced around their circumferences. The magnetic circuit has two parallel paths. One is through the stator and rotor teeth and the other directly links the coil. When the stator and rotor teeth are aligned, the flux linking the coil is small. When the stator and rotor teeth are not aligned, the flux linking the coil is larger. The change in flux linking the coil induces an a.c. voltage in the coil. The frequency of this voltage is proportional to the speed of the rotor.

1. The wheel speed sensor installation is illustrated in Fig. 5-80. The sensor is screwed into the rear wheel spindle and driven through the spindle by a long shaft attached to the cap. Since the rear wheels of a front-wheel drive vehicle rotate independently, one wheel speed sensor is required for each rear wheel. The outputs of the sensors are electronically combined in the controller. A section view showing the internal parts and construction is illustrated in Fig. 5-67. The sensors are serviced only as complete assemblies.

2. Transmission Speed Sensor (Fig. 5-68) – The Transmission Speed Sensor installation is illustrated in Fig. 5-81. The sensor mounts in the transmission in place of the speedometer driven gear assembly. Both the driven gear and flexible shaft coupling are integral parts of the sensor. Since the rear wheels of a rear-wheel drive vehicle are connected through the differential and transmission, the one Transmission Speed Sensor produces an effective speed signal. With 90 teeth on the stator, 15-inch wheels, and a gear ratio of 1.33:1, the resulting transmission sensor output frequency is 25 Hz (cycles) per mph of vehicle speed. A section view showing the internal parts and construction is illustrated in Fig. 5-69.

b. Controller

The controller is the electronic computer in the Track Master System. An outline and section view of the controller are illustrated in Fig. 5-70. This unit contains a hybrid electronic circuit comprising discrete components, a printed circuit board, and a ceramic circuit utilizing thick film technology along with flip chip semiconductors. The circuitry is covered with a protective coating and encased in a plastic housing. Electrical connections are made to the car harness by plug-in connectors.

The controller receives and continuously monitors the input speed signals from the two wheel speed sensors in the case of a front-wheel drive vehicle, or the transmission speed sensor in the case of a rear-wheel drive vehicle. Its basic functions are to determine from the input speed signal when rear wheel lock-up is impending, to generate an electrical output to make a ground circuit which automatically partially releases the rear brakes, to determine when the impending rear wheel lock-up situation ceases to exist, and to remove the output signal and ground which again applies the rear brakes.

The controller accomplishes its basic functions by modifying the wheel speed or transmission speed signal to form a second signal simulating vehicle speed. Both wheel speed or transmission speed and vehicle speed signals are then compared. When their difference increases to a predetermined value, the controller generates the output signal making a ground circuit which releases the rear brakes. with reduced rear braking, wheel speed or transmission speed increases, and when the difference between the wheel speed or transmission speed and vehicle speed signals decreases to a predetermined value, the controller removes the output ground signal, thereby increasing rear braking. This process is repeated as required until the vehicle speed decreases to about 5 mph, or until the brakes are released by the driver.

The controller also contains special circuitry which is used in conjunction with the brake warning light to signal most system malfunctions. The controller is serviced as an assembly.

c. Modulator

The modulator as pictured with the integral solenoid valve in Fig. 5-71 is mounted on the left side of the cowl. In response to the atmospheric air input from the solenoid valve, its basic function is to control or pulse the hydraulic pressure to the rear brakes during maximum braking stops, similar to pumping the brake pedal with your foot.

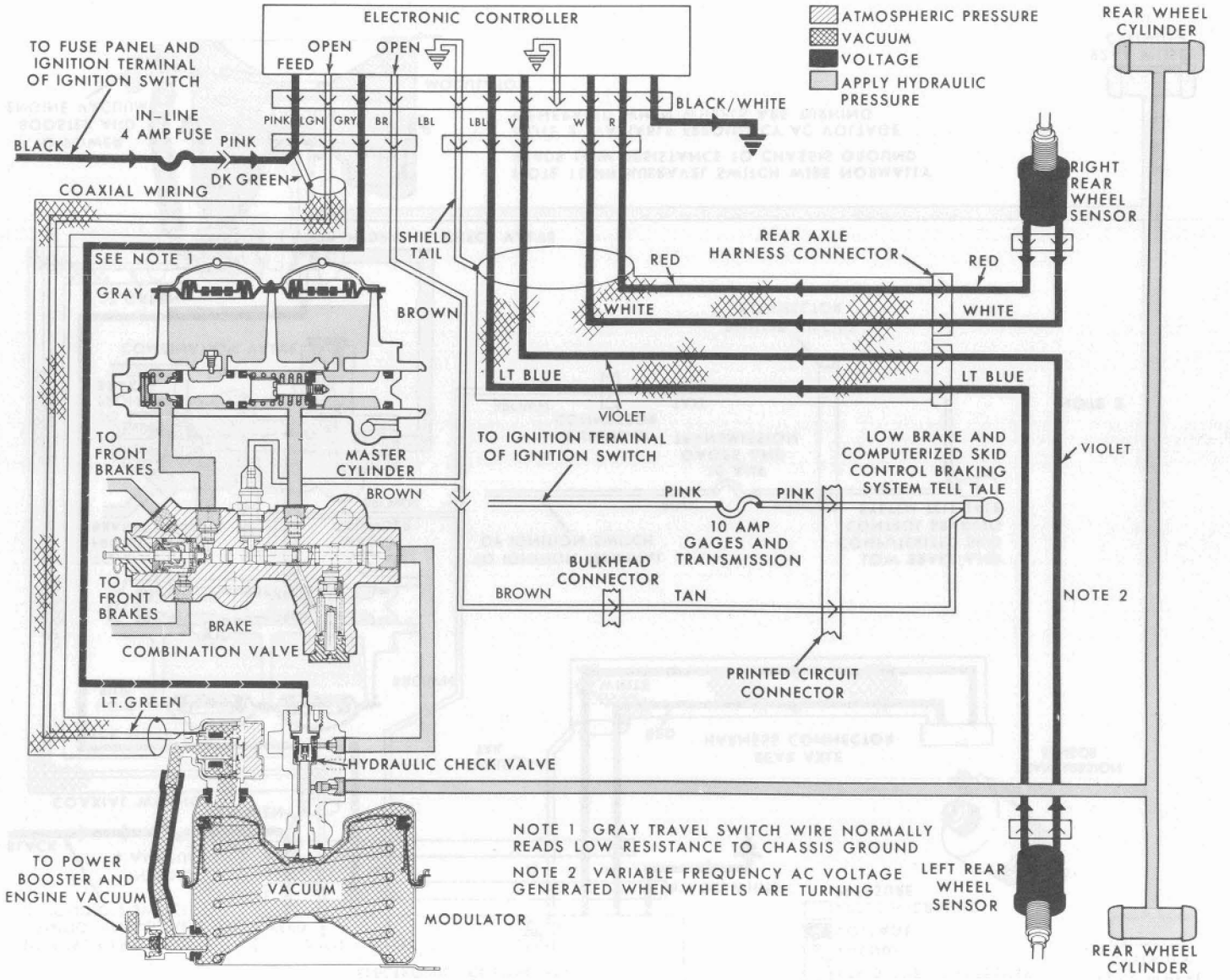


Fig. 5-62 Operation–Normal Braking–Eldorado

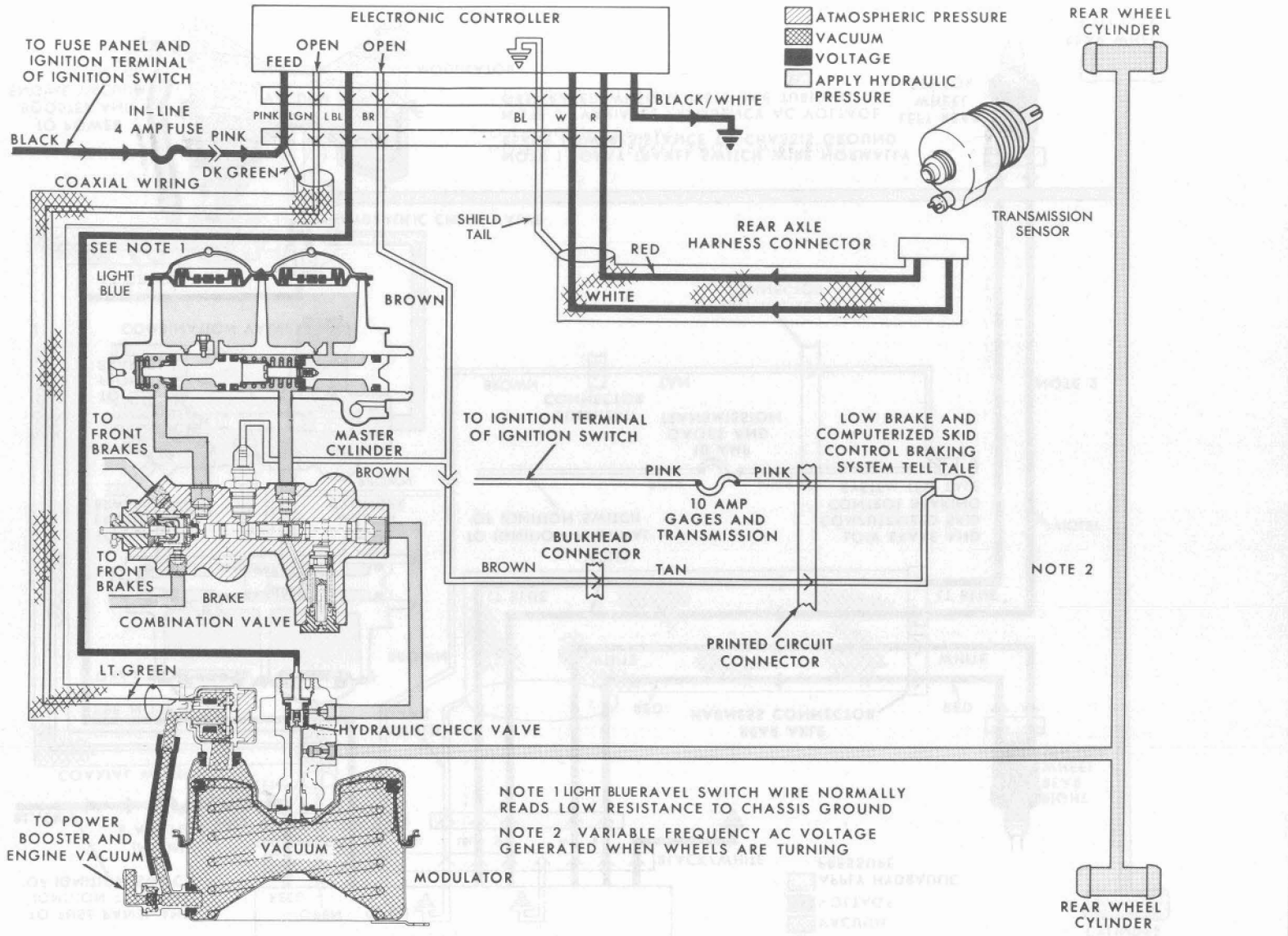


Fig. 5-63 Operation—Normal Braking—Exc. Eldorado

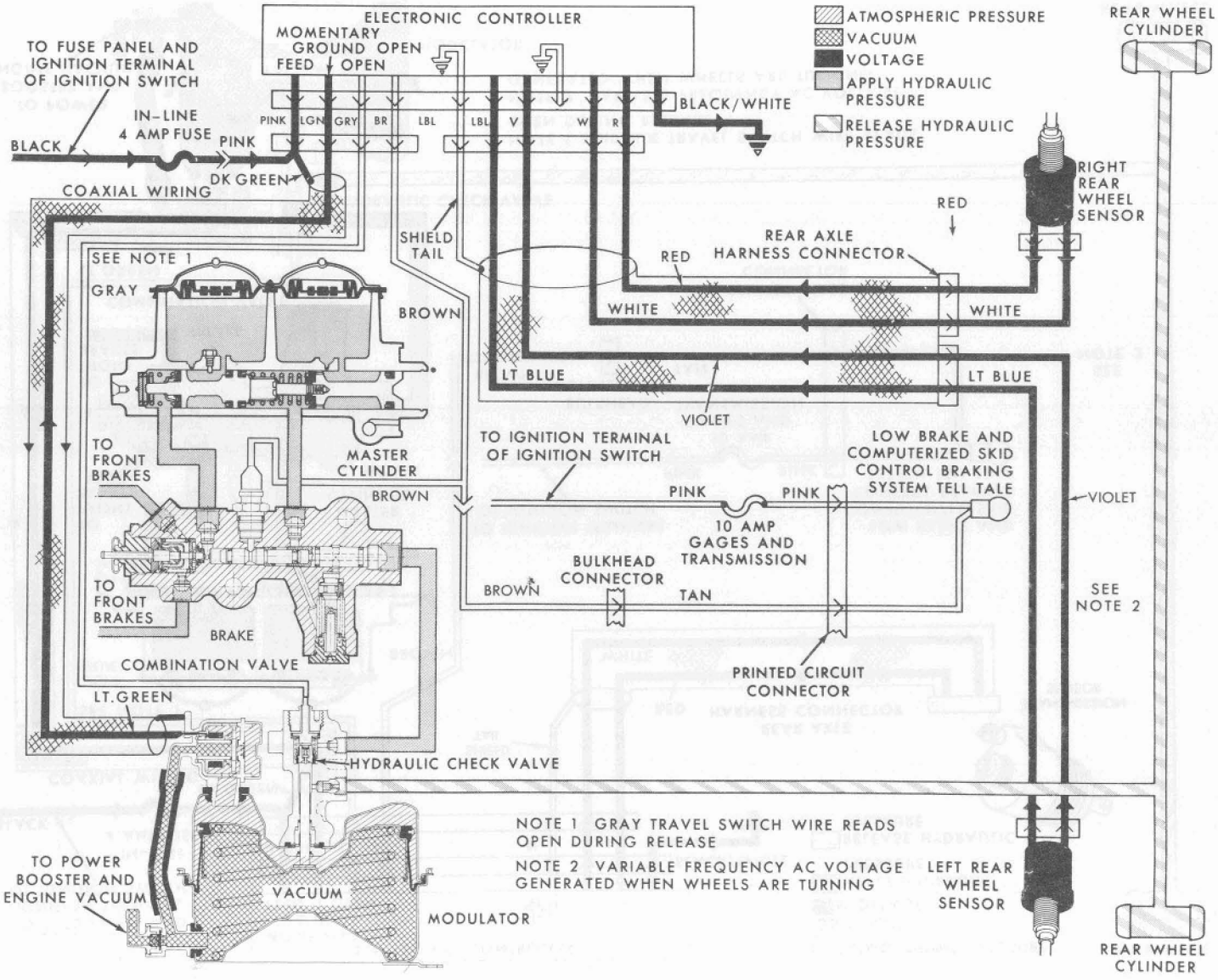


Fig. 5-64 Operation–Release Mode–Eldorado

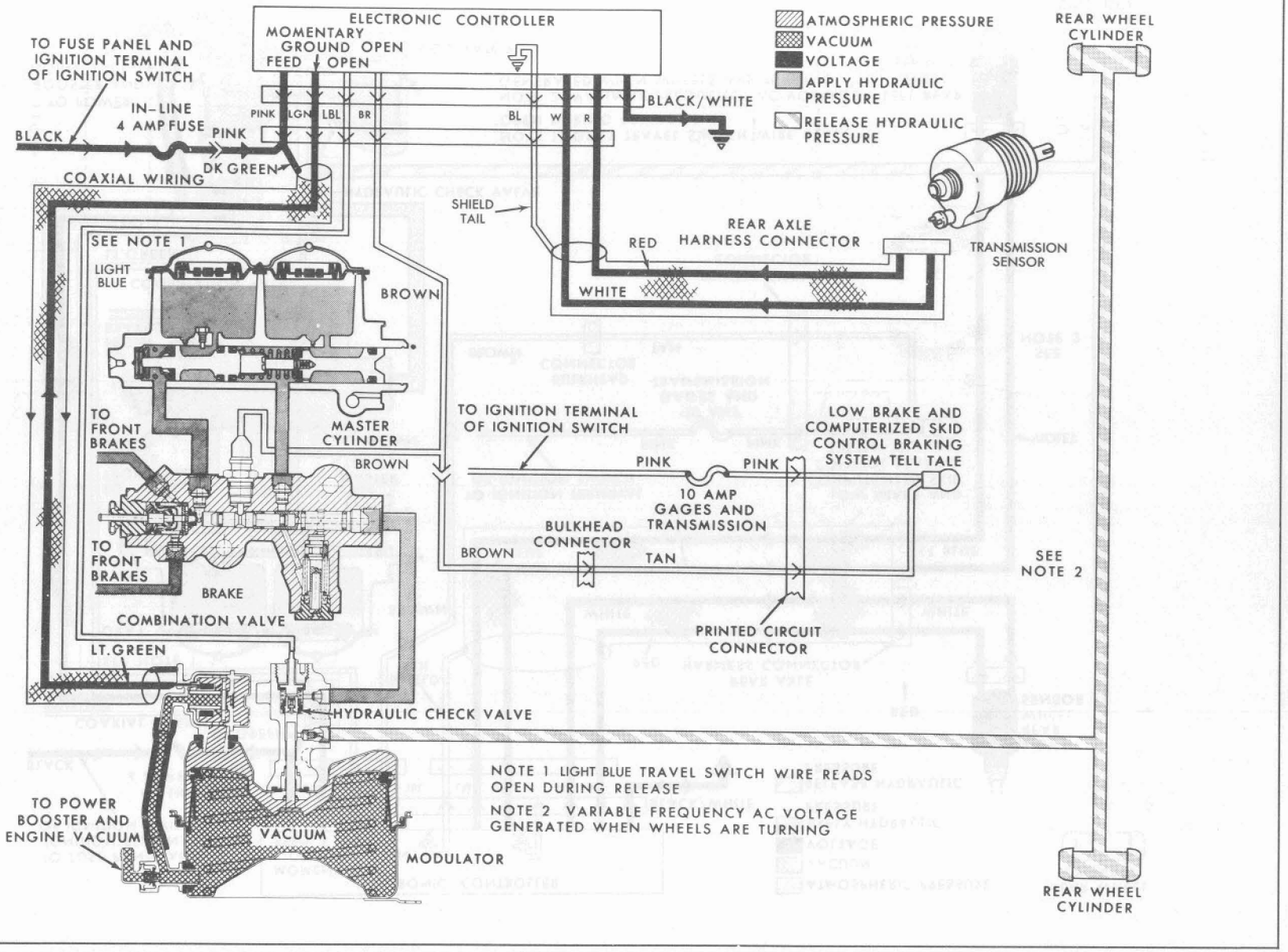


Fig. 5-65 Operation–Release Mode–Exc. Eldorado

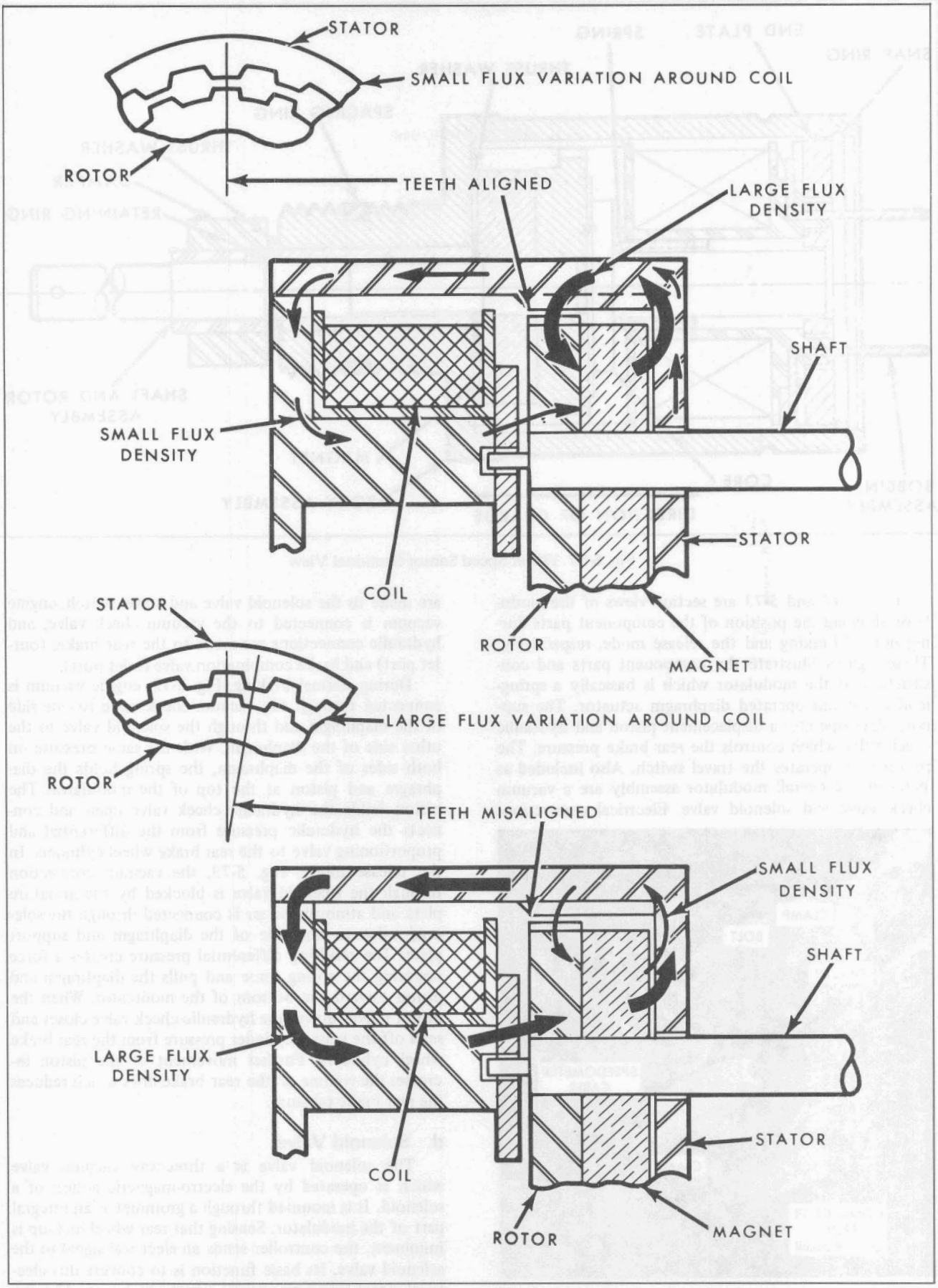


Fig. 5-66 Speed Sensor Magnetic Circuit

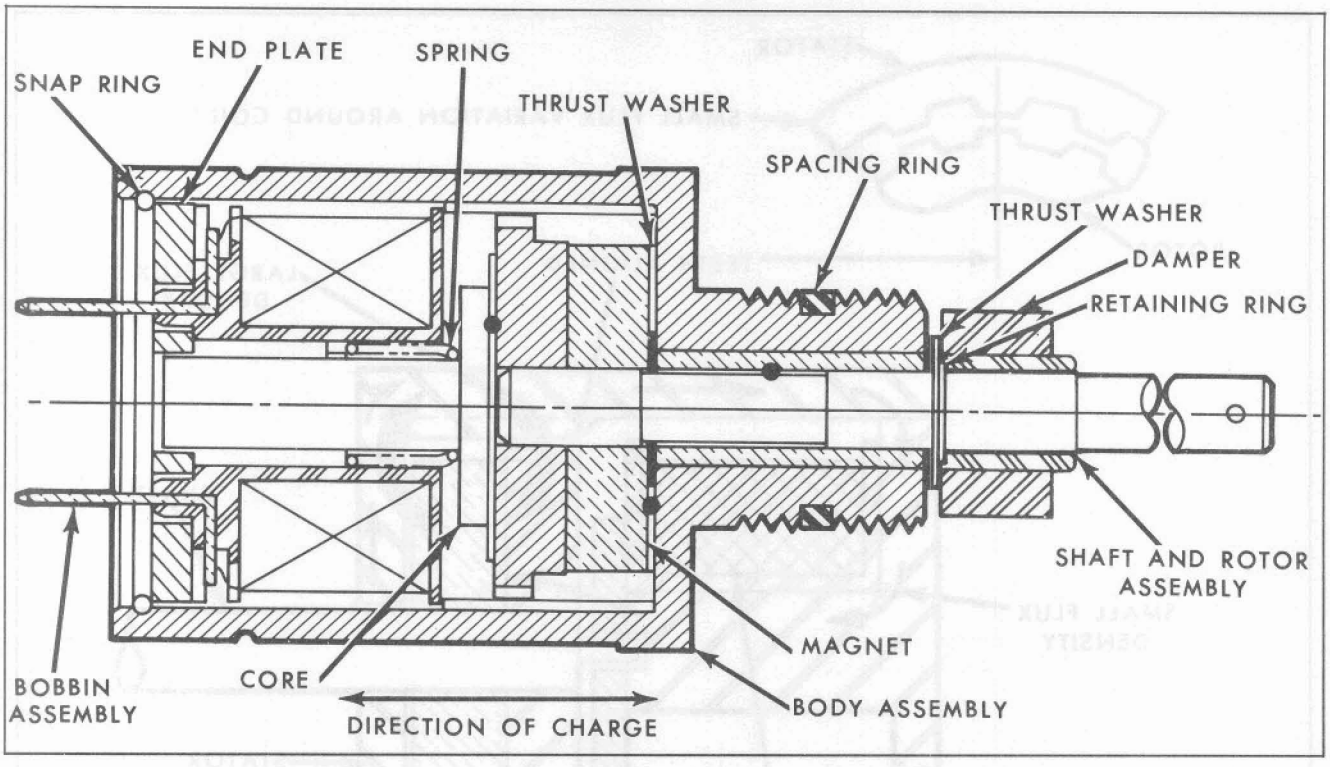


Fig. 5-67 Wheel Speed Sensor Sectional View

Figs. 5-72 and 5-73 are section views of the modulator showing the position of the component parts during normal braking and the release mode, respectively. These figures illustrate the component parts and construction of the modulator which is basically a spring-loaded vacuum operated diaphragm actuator. The support plate operates a displacement piston and hydraulic check valve which controls the rear brake pressure. The piston also operates the travel switch. Also included as parts of the overall modulator assembly are a vacuum check valve and solenoid valve. Electrical connections are made to the solenoid valve and travel switch, engine vacuum is connected to the vacuum check valve, and hydraulic connections are made to the rear brakes (outlet port) and brake combination valve (inlet port).

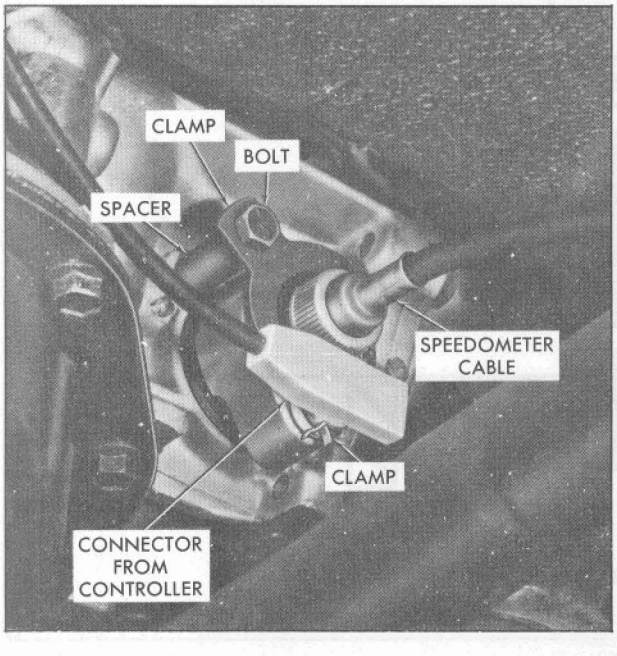


Fig. 5-68 Transmission Speed Sensor

During normal braking, Fig. 5-72, engine vacuum is connected through the vacuum check valve to one side of the diaphragm and through the solenoid valve to the other side of the diaphragm. With the same pressure on both sides of the diaphragm, the spring holds the diaphragm and piston at the top of the modulator. The piston holds the hydraulic check valve open and connects the hydraulic pressure from the differential and proportioning valve to the rear brake wheel cylinders. In the release mode, Fig. 5-73, the vacuum connection through the solenoid valve is blocked by the armature plate and atmospheric air is connected through the solenoid valve to one side of the diaphragm and support plate. The resulting differential pressure creates a force opposing the spring force and pulls the diaphragm and piston toward the bottom of the modulator. When the piston moves down, the hydraulic check valve closes and seals off the master cylinder pressure from the rear brake wheel cylinders. Further movement of the piston increases the volume of the rear brake lines which reduces the rear brake pressure.

d. Solenoid Valve

The solenoid valve is a three-way vacuum valve which is operated by the electro-magnetic action of a solenoid. It is mounted through a grommet as an integral part of the modulator. Sensing that rear wheel lock-up is imminent, the controller sends an electrical signal to the solenoid valve. Its basic function is to convert this electrical signal into a pneumatic signal which is used by the modulator.

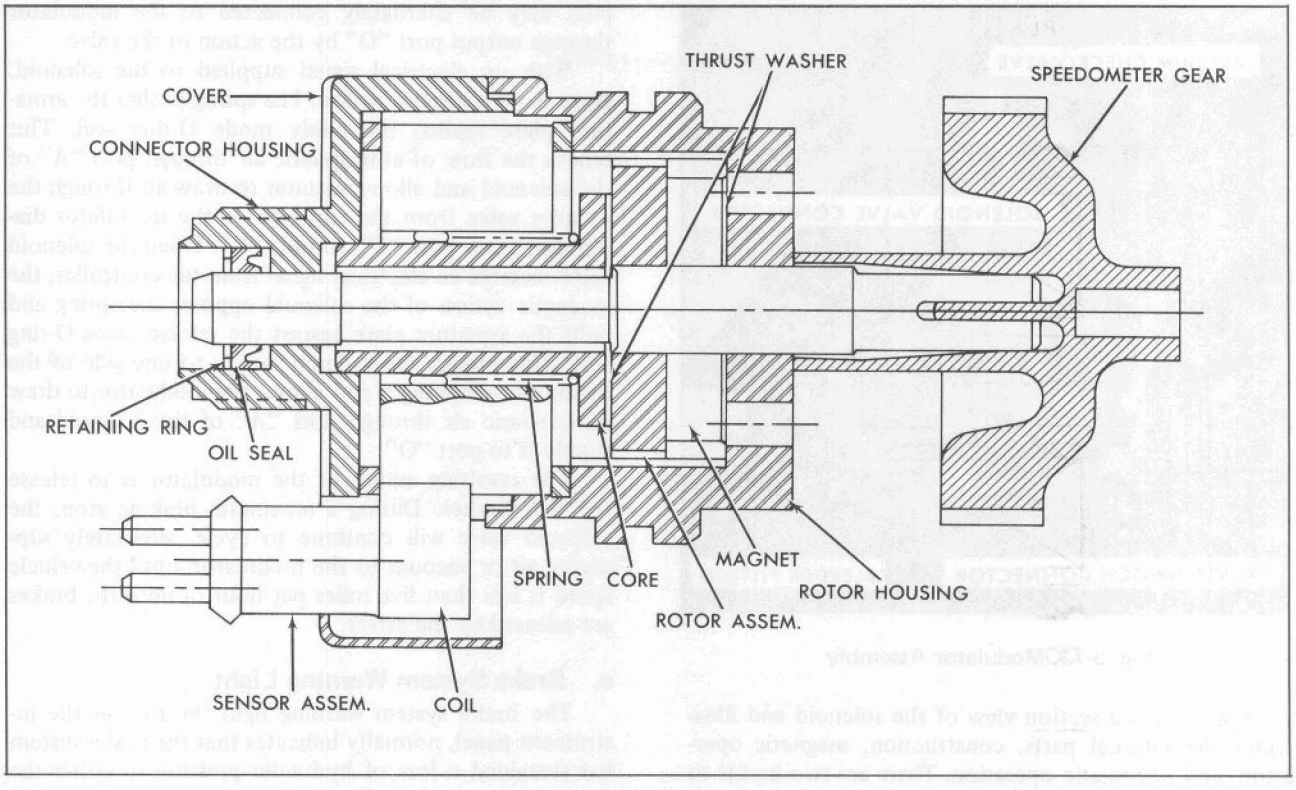


Fig. 5-69 Transmission Speed Sensor Sectional View

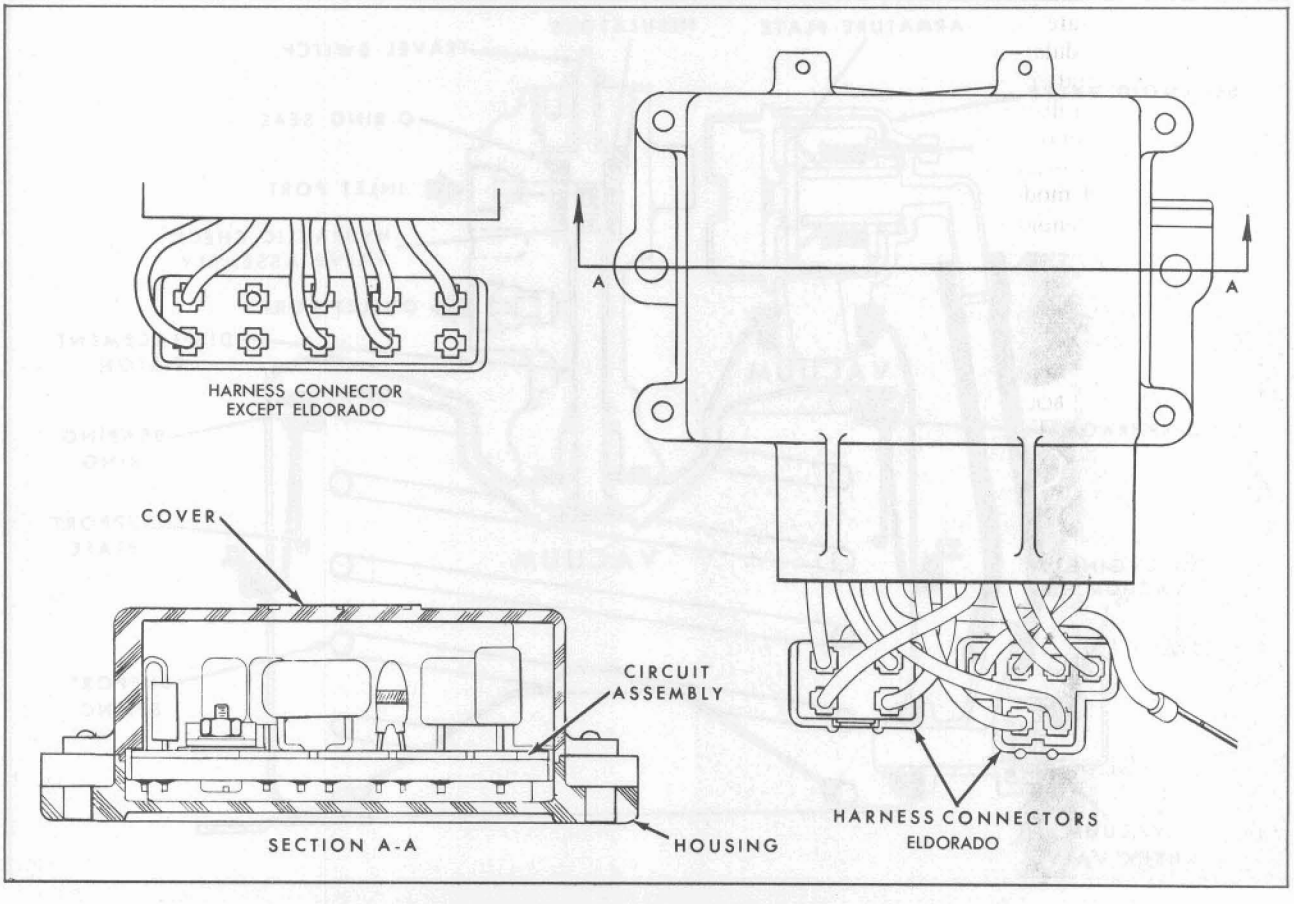


Fig. 5-70 Controller Outline and Sectional View

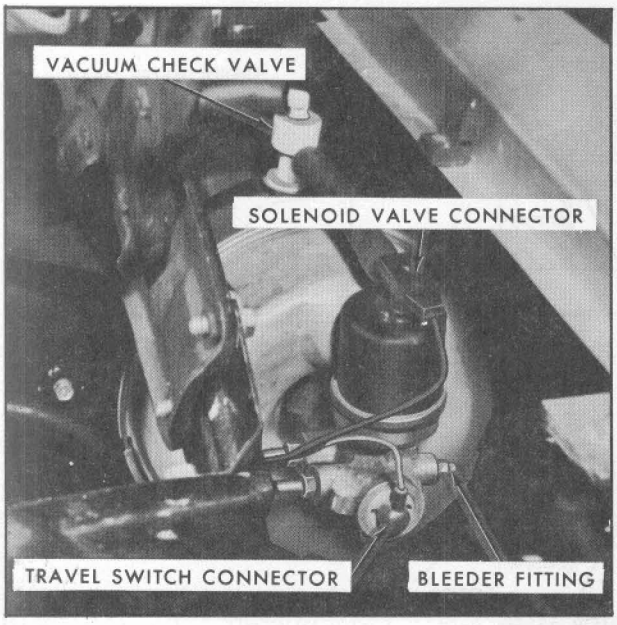


Fig. 5-71 Modulator Assembly

Fig. 5-74 is a section view of the solenoid and illustrates the internal parts, construction, magnetic operation, and pneumatic operation. There are two inputs to the valve. Atmospheric air is supplied through the cover at port "A" and engine vacuum is supplied through a hose connection at port "V". These two pneumatic inputs may be alternately connected to the modulator through output port "O" by the action of the valve.

With no electrical signal supplied to the solenoid, there is no magnetic action. The spring pushes the armature plate against the apply mode O-ring seal. This blocks the flow of atmospheric air through port "A" of the solenoid and allows vacuum to draw air through the vacuum valve from the top side of the modulator diaphragm, from port "O" to port "V". When the solenoid valve receives an electrical signal from the controller, the magnetic action of the solenoid opposes the spring and pulls the armature plate against the release mode O-ring seal. This blocks the vacuum supply to one side of the modulator diaphragm and allows the modulator to draw atmospheric air through port "A" of the solenoid and supply it to port "O".

The resulting action of the modulator is to release the rear brakes. During a maximum braking stop, the solenoid valve will continue to cycle, alternately supplying air or vacuum to the modulator, until the vehicle speed is less than five miles per hour or until the brakes are released by the driver.

e. Brake System Warning Light

The brake system warning light, located in the instrument panel, normally indicates that the brake system has sustained a loss of hydraulic pressure to either the front or rear brakes. The bulb and circuit are checked with the ignition switch in the "START" position, where the brake light should be illuminated.

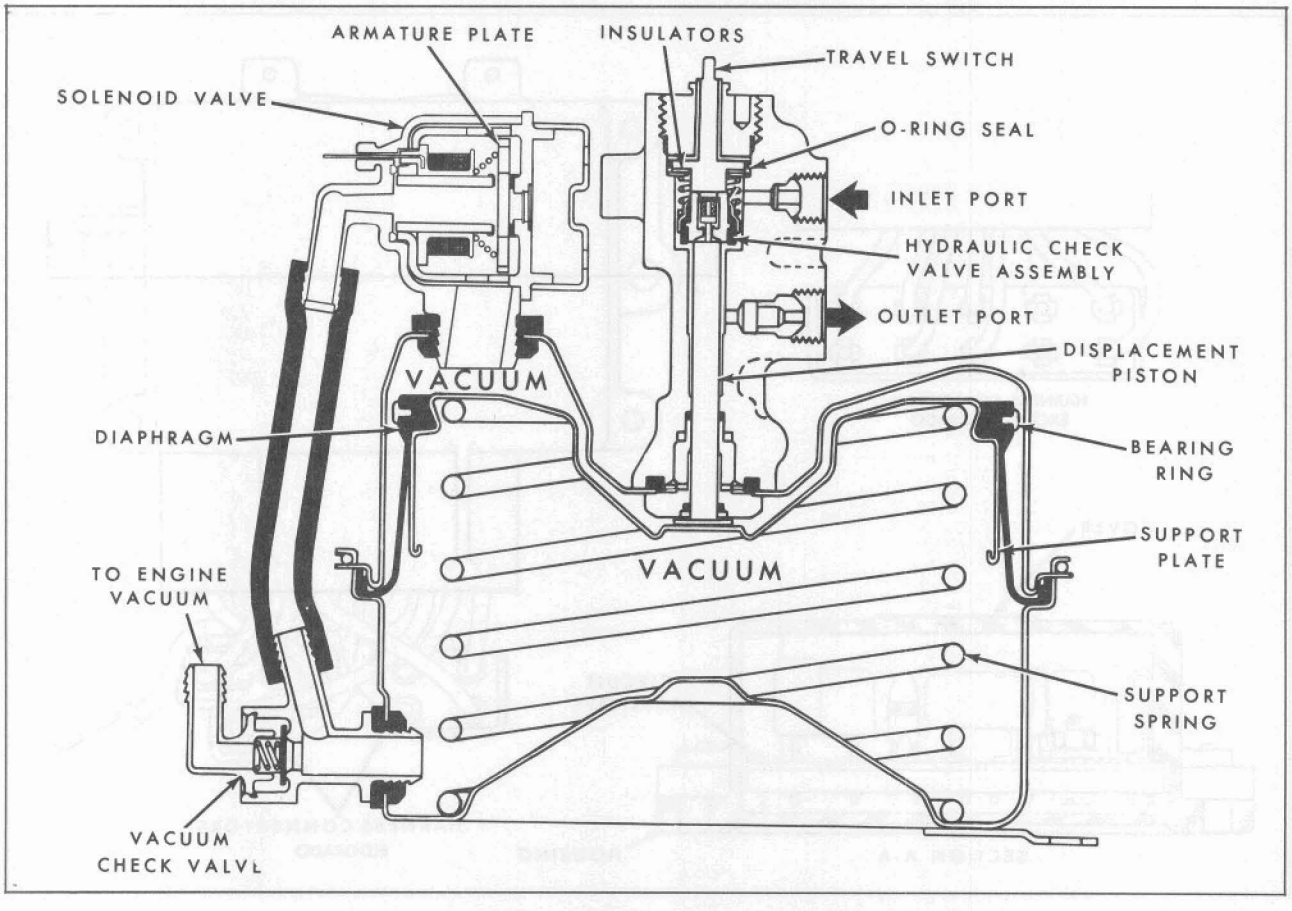


Fig. 5-72 Modulator Assembly–Normal Braking

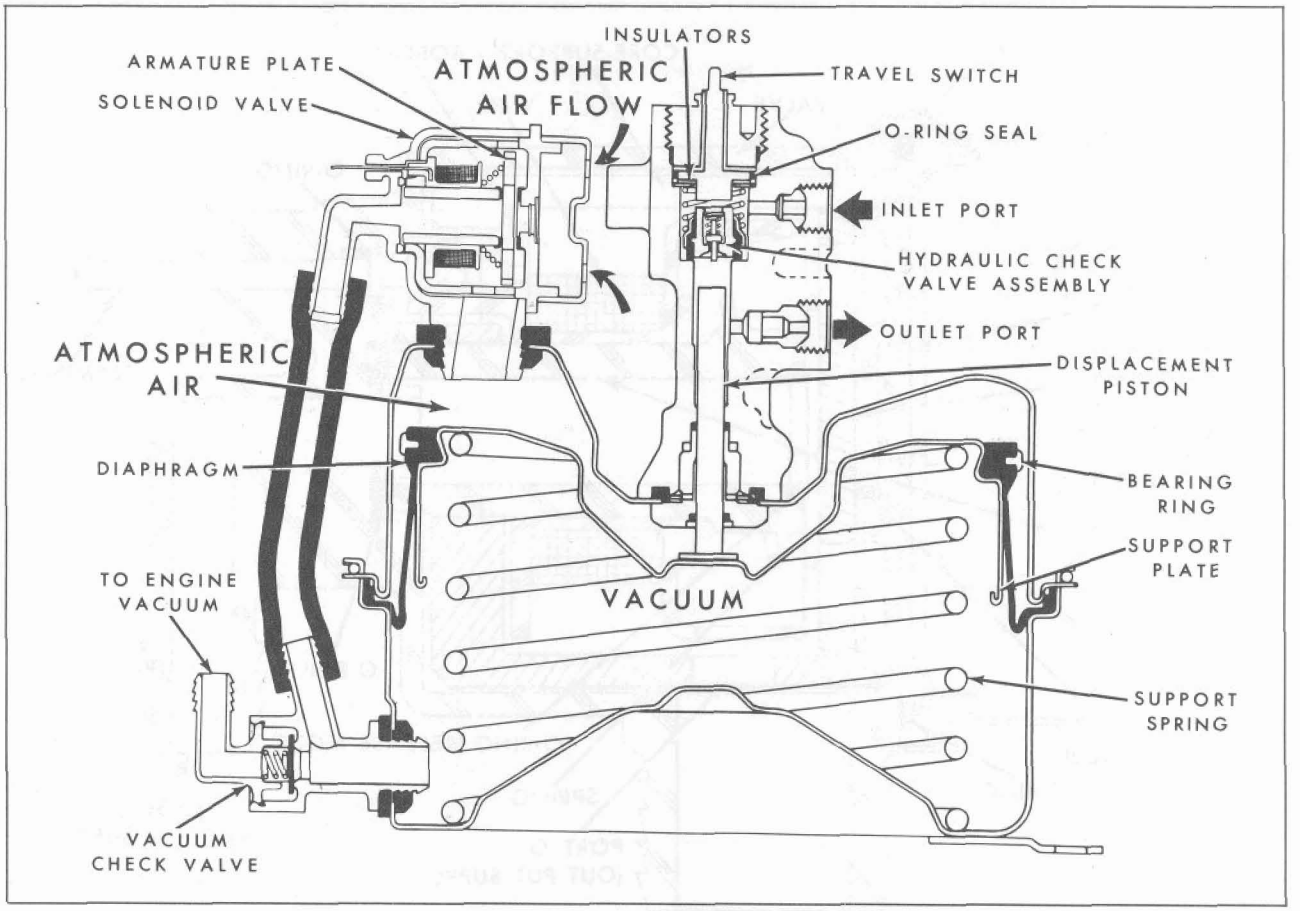


Fig. 5-73 Modulator Assembly—Release

For vehicles equipped with the Track Master option, the brake system warning light also operates in conjunction with the modulator travel switch and special circuitry in the controller to provide a visual indication to the driver in the event of most Track Master System malfunctions. When the travel switch is open more than approximately four seconds (except during a skid controlled stop), the controller turns the tell-tale light on. An exception to this is an open in the 4 amp feed circuit from the ignition switch, which is indicated without the four second delay. When a malfunction is detected, the warning light is illuminated and remains illuminated until the ignition switch is turned off. Any malfunction indication requires immediate service to the hydraulic system or Track Master System.

In the event of many types of malfunctions, the rear brake operation automatically reverts to a standard system; i.e., normal operation without the Track Master System option. For certain malfunctions, the restoration of standard brakes is accomplished by a special controller circuit which prevents the generation of an output brake release signal whenever a malfunction indicates signal exists in the brake system warning light circuit.

f. Electrical Harness

1. The Eldorado Track Master System wiring harness consists of three main sections: rear axle harness, which runs from the rear wheel sensors to a rear axle harness connector; front harness running from the rear axle harness connector to the controller; and a controller and modulator harness, running from the controller to the ignition circuit and modulator.

Connectors for the speed sensors and solenoid valve are molded waterproof-type with appropriate clamps to insure sealing.

2. The C-car Track Master wiring harness consists of a body harness running from the transmission sensor to the controller; and a controller and modulator harness, running from the controller to the ignition circuit and modulator.

The solenoid cable is unique in that it has a single conductor with a braided copper shield and insulating jacket. Contrary to usual practice, the shield is not at ground potential, but is at battery potential. This has been done so that if the solenoid cable is shorted, the control system fuse will blow and the brake system will function in a standard manner. If the system were not designed to blow the fuse, a short in the ground side of the solenoid circuit (light green wire) would keep the rear brakes continuously released.

Mobile Radio Equipment

(NOTE: The electronic portion of the Track Master system may be affected by some types of mobile radio transmitting equipment installed in your Cadillac. Such

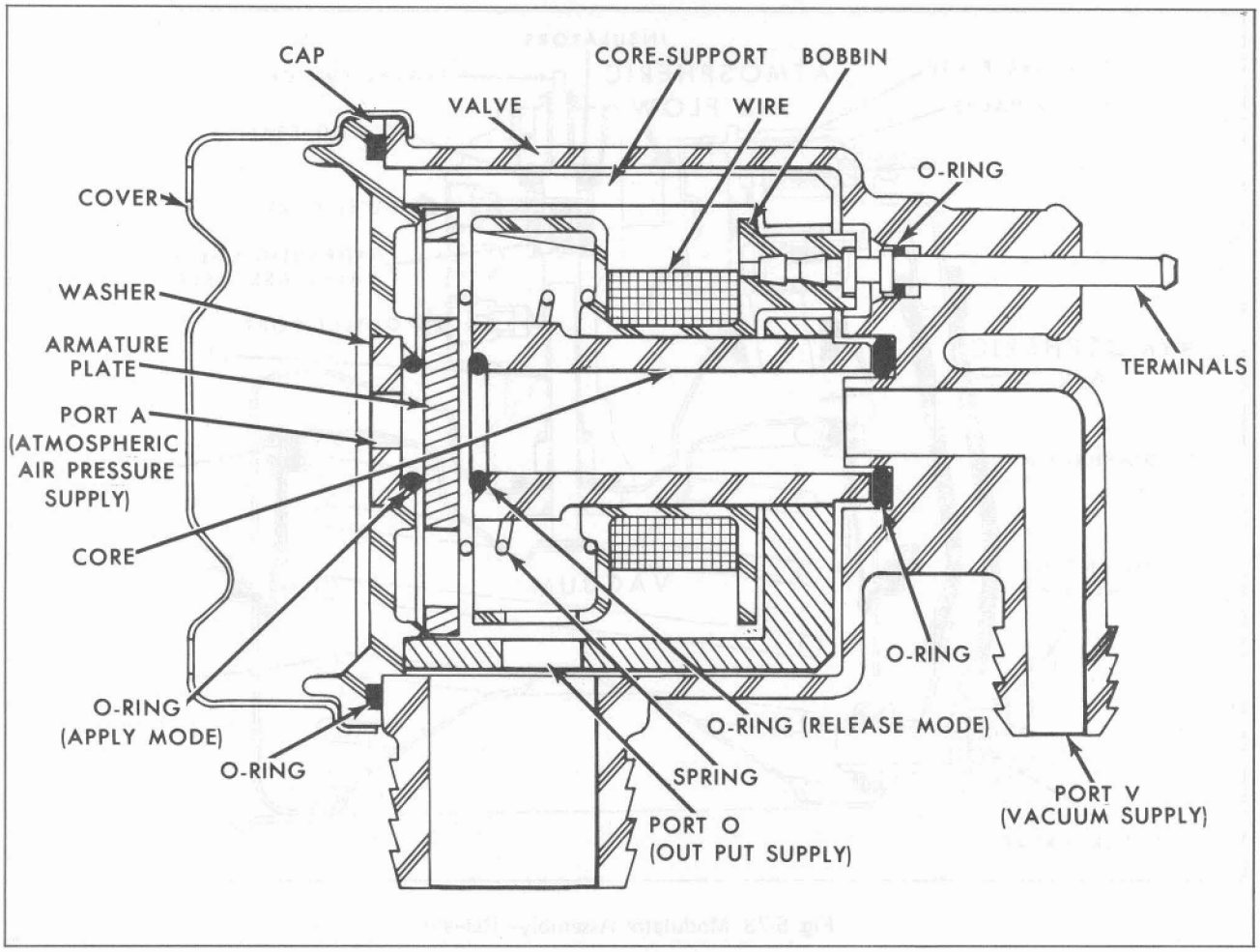


Fig. 5-74 Sectional View–Solenoid

interference may exist while transmitting, causing intermittent release of the rear brakes or disengagement of the Track Master system. If the system is disengaged, the brake warning light will come on and standard braking will be possible. Citizen's band radios, electronic garage door openers and similar devices with 5 watts or less input, as well as mobile telephone equipment installed by your local telephone company in accordance with Bell System Procedure 404-300-200, or equivalent, will not affect Track Master operation. Other types of radio transmitting equipment, i.e., amateur radio, Public Land Mobile radio, etc. in your Track Master equipped Cadillac will require the installation of a special filter.)

DIAGNOSIS

36. Diagnosis

a. How to Use Diagnosis Guide

The operation of the brake tell-tale light is important when analyzing a Track Master problem. Any abnormal brake light indication means there is a problem in the hydraulic system or the Track Master System. In addition, if the light does come on, it is important to know if turn on is immediate or there is a delay. The lack of an exercise cycle or the presence of pseudo cycling also indicates a Track Master problem. The diagnosis guide, in large part, is based on these four underlined characteristics and a definition for each is listed in Part b.

Most problems will fall into one of these conditions. However, the system may exhibit none of the four failure characteristics and still not cycle during an impending wheel lock.

If an owner complains of this situation, the only recourse is to observe the operation under wheel lock conditions. Part c is a test used to simulate wheel-lock so the operation of the system may be observed.

After it is positively determined that a problem exists, the first step is to remove the system in-line 4 amp fuse, disconnect both controller connectors and use an ohmmeter to check for the presence of open or short circuits as described in Part d.

The diagnosis guide, Part 3, is keyed to information obtained in Parts b, c, and d.

b. Definitions

Definition of "Immediate" Brake Light:

The brake light comes on immediately when the ignition switch is turned to the "ON" position.

Definition of "Delayed" brake Light:

A delayed brake light comes on two to five seconds after the ignition switch is turned to the "ON" position.

When a delayed brake light is encountered, it is normally the result of the Track Master self-check circuitry detecting a problem in the system. When this occurs, the self-check circuit latches off the Track Master and latches the brake lamp on. Finding the problem and taking corrective action at this time (with the ignition on) will not result in the brake light going off, as it is latched on. In order to reset the Track Master self-check circuit and turn the brake lamp off, it is necessary to turn the ignition off. After doing so, it may be again turned on and the engine started, to evaluate the corrective action and/or continue the diagnosis procedure.

Definition of Exercise Cycle:

Each time the ignition switch is turned on, the Track Master controller sends a short signal to the modulator assembly. This signal energizes the solenoid valve, which in turn allows the modulator to partially cycle if there is vacuum in the system. This exercise cycle can be detected audibly or by feeling the modulator while someone turns the ignition switch on; however, the only positive way to determine if the exercise cycle is normal is to check it with vacuum in the system (running engine for a few seconds will provide sufficient vacuum) and with an ohmmeter connected from the modulator travel switch terminal to ground. If the ohmmeter reading indicates that the modulator travel switch has changed from "closed" to "open" and back to "closed" again when the ignition switch is turned to the "on" position, the exercise cycle is normal.

Definition of Pseudo Cycling:

The Track Master System's basic function is to maintain vehicle stability during maximum effort stops by keeping the rear wheels from skidding. This action can take place at varying degrees of brake pedal effort as determined by brake effectiveness, slipperiness of road surface, etc., and normal cycling will be experienced when the controller senses the rear wheels starting to lock up. This is "normal" operation. Cycling of the system, random or otherwise, when not braking the vehicle or when light (normal) brake stops are being made would be considered "pseudo cycling".

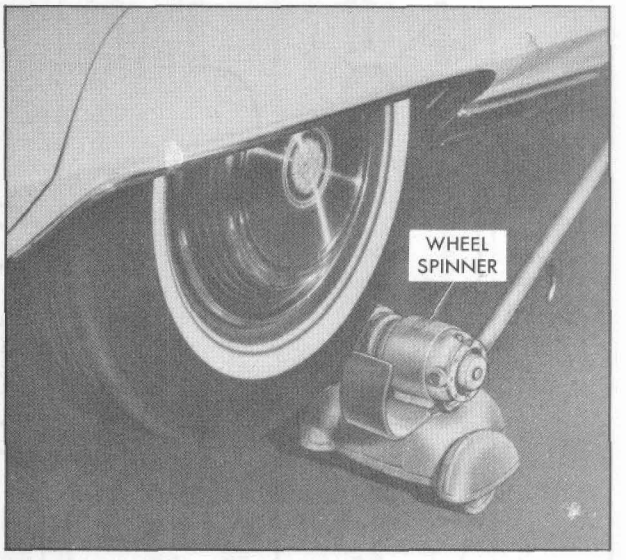


Fig. 5-75 Rotating Wheel

c. Operational Check

1. C-Car – Raise and support rear end of vehicle so the rear wheels are above the floor. Start the engine, shift into "drive" range and accelerate wheels to approximately 40 mph (speedometer). Apply the brake firmly and observe the speedometer. The speedometer should reflect the cycling of the rear wheels and should gradually approach 0 mph. Also, the cycling of the rear wheels normally can be felt as well as heard. If the speedometer goes directly to "0" mph from 40 mph when the brake is applied, the wheel lock control system is inoperative.

2. Eldorado – Raise and support rear end of vehicle so that rear wheels are above the floor. Start the engine. Use the following procedure for each rear wheel: rotate wheel at high speed using wheel spinner of Dynamic Wheel Balancer, Fig. 5-75. Remove drive motor from wheel, apply brake firmly and observe rear wheel for cycling. If wheel stops immediately after application of foot brake, system is not operating normally.

d. Controller Connectors Check (Fig. 5-64)

Resistance and continuity checks should be made at the harness connectors with the controller disconnected, and with the Track Master System power lead disconnected at the 4 amp in-line fuse. Normal readings are shown in Fig. 5-76 and 5-77.

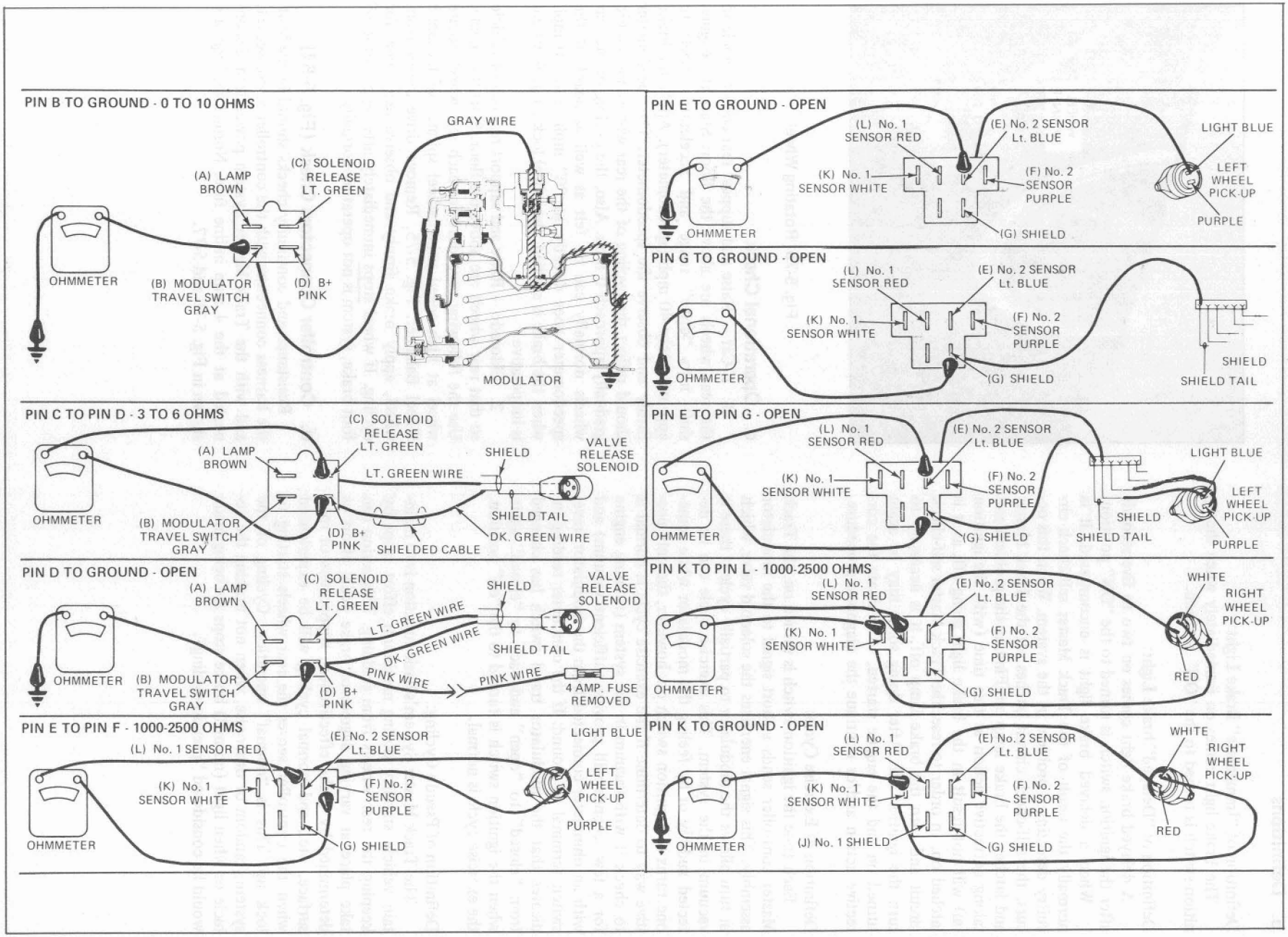


Fig. 5-76 Resistance and Continuity Checks—Eldorado

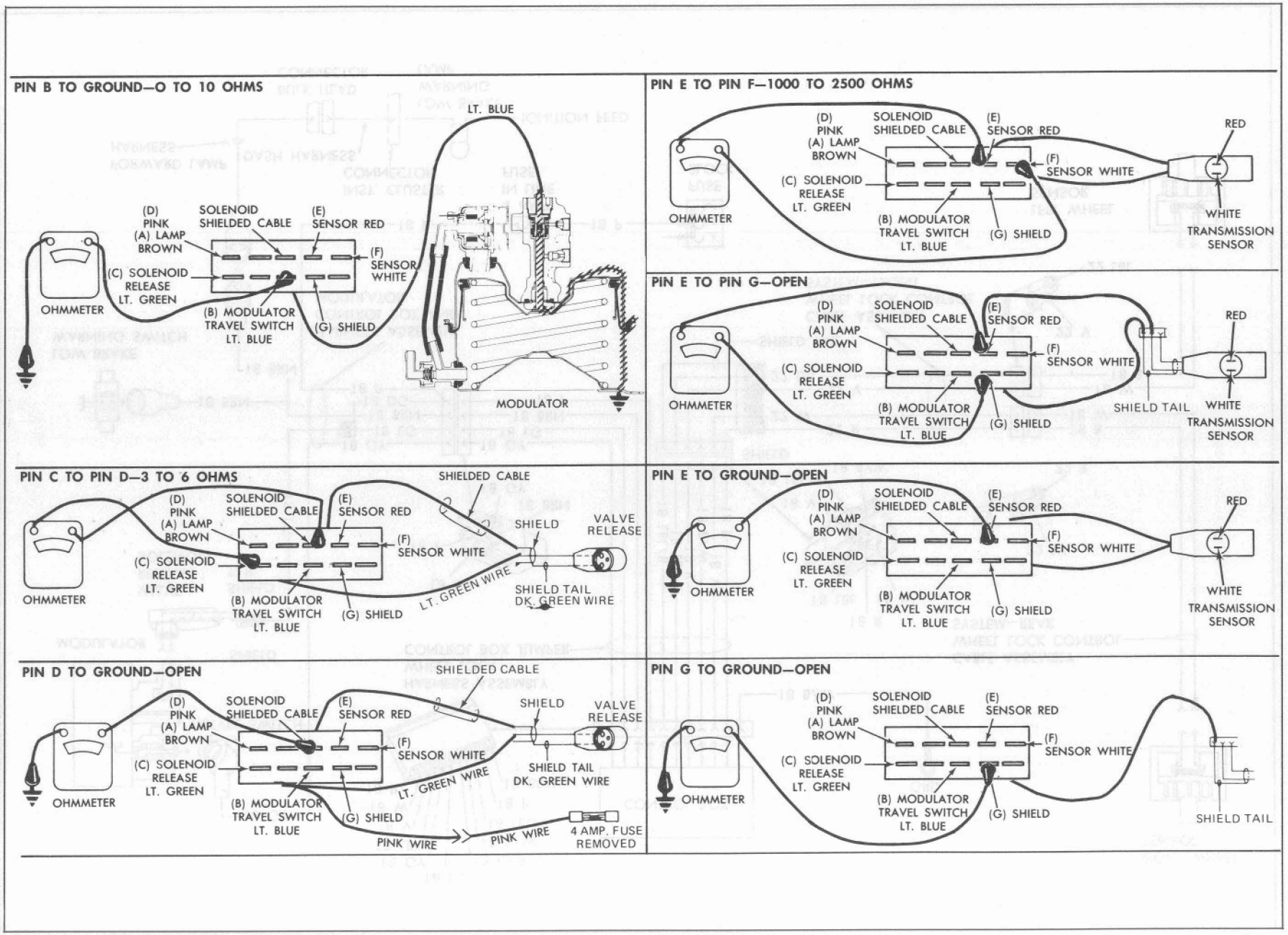


Fig. 5-77 Resistance and Continuity Checks—Exc. Eldorado

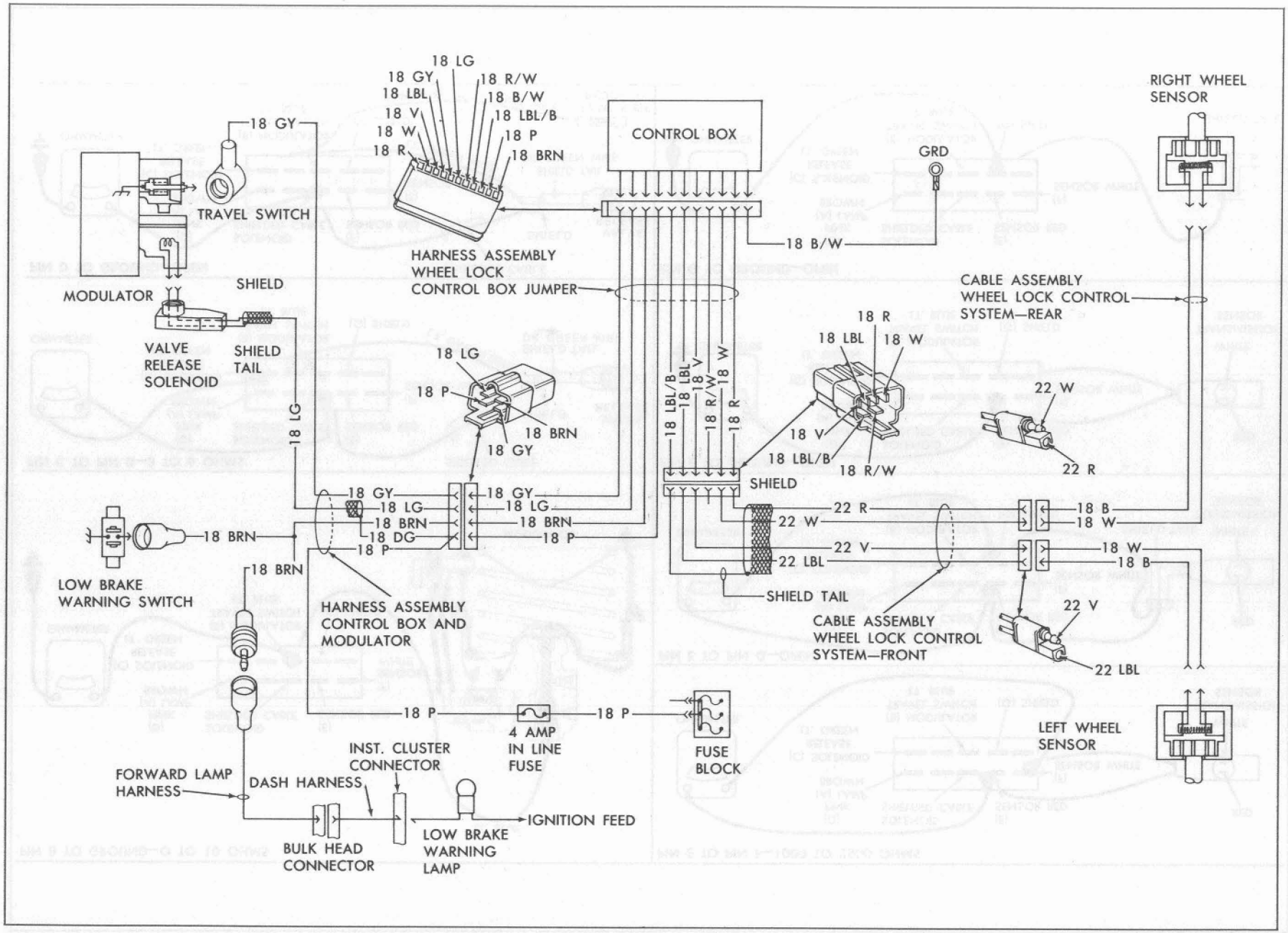


Fig. 5-78 Circuit Diagram—Eldorado

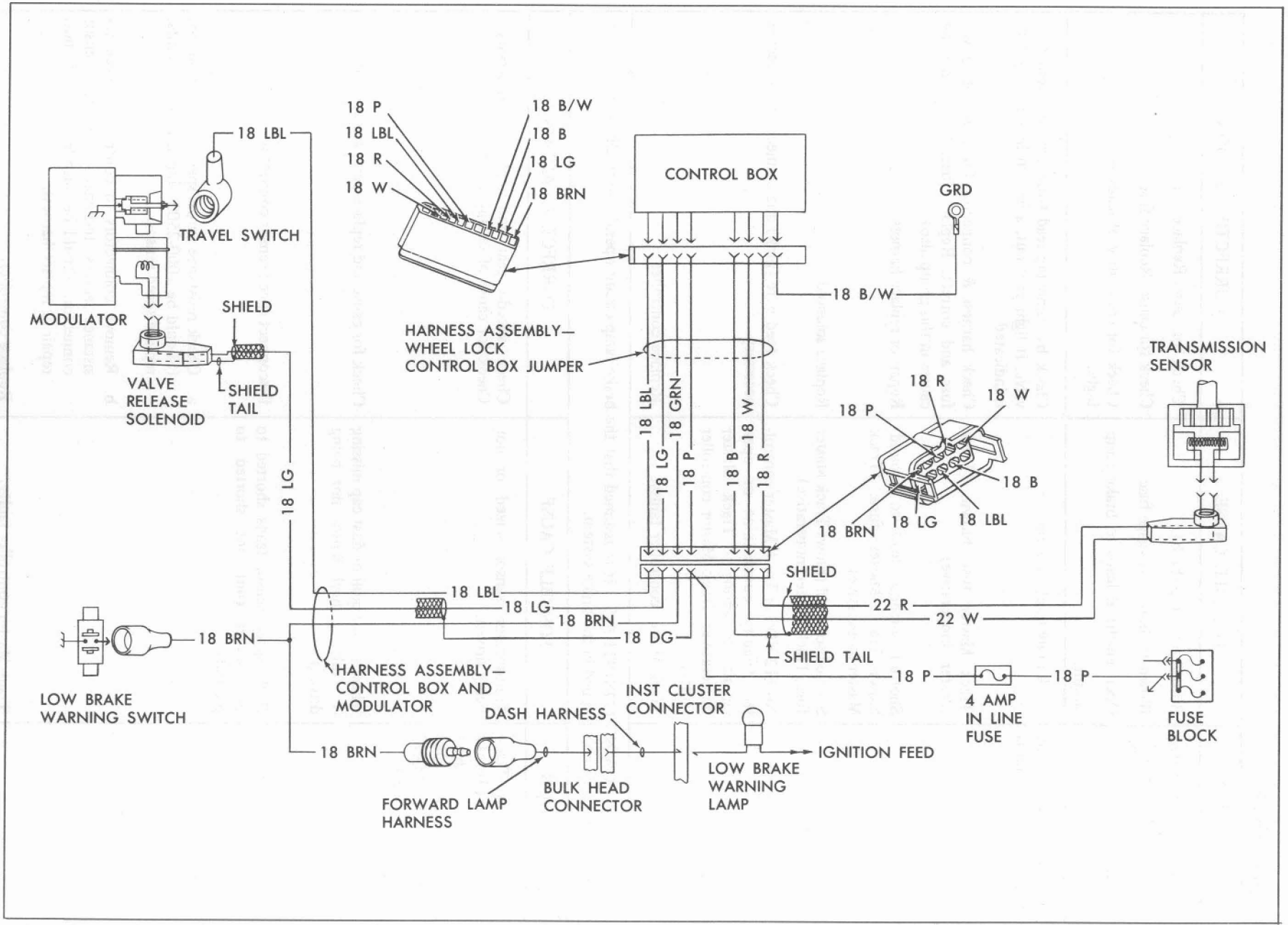


Fig. 5-79 Circuit Diagram—Exc. Eldorado

Diagnosis Guide

CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
No brake light under any condition (check by placing ignition in "START")	Burned out lamp (bulb).	Check for cause. Replace bulb.
	Blown 10 amp trans - gage fuse	Check for cause. Replace fuse.
	Open electrical leads to brake lamp circuit.	Check for continuity of leads and correct accordingly.
Immediate brake light when ignition switch is turned "ON")	Leak in hydraulic system.	Check by removing lead from brake combination valve. If light goes out, a leak in hydraulic system is indicated.
	Track Master fuse blown. (Track Master inoperative)	Check harness & connector for cause of blown fuse and correct. Replace fuse. (See remaining causes in this group also)
	Shorted solenoid lead to ground-blows Track Master fuse. (Track Master inoperative)	Repair or replace harness.
	Shorted solenoid (blows Track Master fuse, Track Master inoperative)	Replace solenoid.
	No +12 VDC at Track Master controller. (Faulty connections or open circuit in wiring - Track Master inoperative) Track Master controller faulty.	Check feed wire (pink) and connectors. Correct as necessary.
	Track Master controller faulty.	Replace controller.

FOR THE FOLLOWING CONDITIONS: It is assumed that the brake lamp circuit operates normally and there are no hydraulic leaks or air trapped in the brake system.

CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
No brake light. Track Master completely inoperative but exercise cycle OK. (Ignition switch "ON" or engine running.)	Transmission sensor seized or not being driven.	Check speedo gear and replace if necessary. Check for cause of seizing and replace.
	Wheel sensor quill or dust cap missing or faulty (wheel sensor not being driven).	Check for cause and replace parts as necessary.
	Both speed sensor leads shorted to each other (but not shorted to ground)	Disconnect speed sensor connectors. a. Check resistance across speed sensor terminals. (Should be 1000-2500 ohms). If out of limits, replace speed sensor. b. Remove connectors to controller. Check resistance across terminals at speed sensor connector. Should be infinite (open). If not, repair or replace harness.
	Track Master controller faulty.	Replace controller.

CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
No brake light. Track Master completely inoperative and no exercise cycle (ignition switch "ON" or engine running).	Loss of ground connection to Track Master controller.	Check ground lead connection from controller. (Black/white wire)
	Controller connector not plugged into controller and modulator harness.	Plug in connector.
	Solenoid valve seized in de-energized position.	Disconnect solenoid lead. a. Momentarily apply 12 volts to solenoid terminals and listen for solenoid core movement (sharp click). If inoperative, replace solenoid. b. Apply 12 volts to solenoid terminals for 2-3 seconds and observe if vacuum leak stops after solenoid "clicks" (with engine running). If vacuum leak does not stop, replace solenoid.
	Modulator seized in de-energized position.	Disconnect gray modulator travel switch wire. Connect ohmmeter from modulator travel switch to ground. With the engine running, pull solenoid valve out of modulator port and observe ohmmeter. If ohmmeter reflects a change from very low resistance to high resistance as the solenoid valve is removed, the modulator is OK. If not, replace the modulator.
	Track Master controller faulty.	Replace controller.
Brake light comes on after a 2-5 second delay. Track Master completely inoperative but exercise cycle OK. (Ignition switch "ON" or engine running.)	Speed sensor leads open	Check speed sensor connectors for secure connection. Disconnect connectors and check continuity across sensor terminals - should be 1000-2500 ohms. If not, replace sensor(s). Remove connectors to controller and check resistance across terminals E & F and K & L at harness connector with the speed sensor connector(s) reconnected (should be 1000-2500 ohms) - if open, replace harness.
	Speed sensor lead(s) shorted to ground.	Disconnect speed sensor connectors and check continuity of speed sensor terminals to ground. If any terminal is grounded, replace speed sensor. Remove connectors to controller. Check continuity of speed sensor connector terminals to ground. If any terminals are grounded, replace harness.
	Modulator travel switch open.	Remove gray wire connector from modulator travel switch terminal. Check for 0-10 ohm resistance reading from terminal to ground. If out of limits, replace modulator.
	Modulator travel switch connector not making contact with the terminal or open circuit in the lead.	Check gray wire connector at modulator travel switch terminal for security. Remove gray wire modulator travel switch connector from terminal and insert jumper from connector to ground. If system now operates

CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Brake light comes on after a 2-5 second delay. Track Master completely inoperative but exercise cycle OK. (Ignition switch "ON" or engine running.) (Cont'd.)	Modulator travel switch connector not making contact with the terminal or open circuit in the lead. (Cont'd.)	normally, the travel switch is faulty, requiring modulator replacement. If system is still inoperative, check continuity of modulator travel switch lead. If open, repair or replace harness.
	Track Master controller faulty.	Replace controller.
Brake light comes on after a 2-5 second delay. Track Master completely inoperative and no exercise cycle. (Ignition switch "ON" or engine running.)	Solenoid lead(s) open.	Check connector at solenoid valve for security. Remove connector and check resistance of solenoid (3-6 ohms). If out of limit, replace solenoid. Remove controller and modulator harness connector at controller. Also disconnect pink 12 volt feed wire to harness by removing in-line 4 amp fuse. Check continuity of terminals C & D, Fig. 5-76 and/or 5-77, at the harness connector with a jumper temporarily inserted across the solenoid valve connector terminals. If open, repair or replace harness.
	Track Master controller faulty.	Replace controller.
	Mobile radio transmission equipment.	Shield Track Master. Relocate transmitter equipment.
Pseudo cycling while vehicle is in motion.	Frayed shield leads causing intermittent short.	Visually check shields leads and connectors for stray strands of wire. Repair or replace harness as required.
	Sensor drive shaft rubbing in wheel spindle.	Replace sensor.
	Missing or damaged insulators.	Replace insulators.
	Sensor Damper Deteriorated	Replace sensor.
	Bad electrical connections.	Clean connector.
	Track Master controller faulty.	Replace controller.
	Mobile radio transmission equipment.	Relocate transmitter equipment. Shield Track Master.
Pseudo cycling while vehicle is parked (with engine running or ignition switch "ON").	Bad electrical connections.	Clean the connection.
	Track Master controller faulty.	Replace controller.
Does not cycle down to 5 mph during maximum braking effort stop.	Insufficient operating vacuum.	Look for severe vacuum leak and correct.
	Track Master controller faulty.	Replace controller.
Brake light on 2-5 seconds after high brake pressure is applied.	Defective brake combination valve (excessive peressure applied to modulator).	Replace brake combination valve.

SERVICE INFORMATION

CAUTION: Never operate the system unless the *controller has a good ground. Never reverse battery polarity and always connect battery booster cables positive to positive and negative to negative.*

37. Wheel Speed Sensor (Fig. 5-80) (Eldorado Only)

a. Removal

1. Remove rear wheel disc.
2. Remove three screws that secure cap to hub assembly and remove cap.
3. Remove two insulators from sensor assembly pin and remove pin.

(NOTE: A new pin will be required during installation.)

4. Remove spindle as described in Section 4, Note 37a.
5. Position clamp that secures rear harness connector on body of sensor and remove rear harness connector.
6. Place spindle on bench using a 1-5/8" open end wrench, remove sensor assembly from spindle.

b. Installation

1. Install sensor assembly into spindle and tighten until it is snug. The factory torque specification is 20 foot-pounds.
2. Fill rear harness connector with an adequate supply of lubricant and secure the connector to the sensor assembly with clamp.
3. Install spindle as described in Section 4, Note 37b.
4. Install a new pin into sensor assembly and center pin in the spindle within .020". Install two insulators on pin.

(NOTE: It will be necessary to carefully work the pin into the spindle.)

5. Position cap on hub assembly so it is aligned with pin. Tighten three screws that secure cap to 20 inch-pounds.
6. Install rear wheel disc.

38. Transmission Speed Sensor (Fig. 5-81)

a. Removal

1. Disconnect speedometer cable at transmission sensor.
2. Release clamp at harness connector and remove connector.
3. Remove one bolt, retainer and spacer securing sensor to transmission.
4. Remove sensor from transmission.

b. Installation

1. Install sensor with speedo gear in transmission.
2. Install spacer, retainer and bolt securing sensor to transmission.
3. Install harness connector packed with front wheel bearing grease to sensor and secure with clamp.
4. Connect speedometer cable to sensor.

39. Controller

a. Removal

1. Working under instrument panel just to left of glove box, remove wiring harness connector from controller.
2. Remove two screws that secure controller and remove controller.

b. Installation

1. Secure controller and ground wire with two attaching screws.
2. Secure connector at controller.

40. Modulator

a. Removal

1. Disconnect positive battery cable.
2. Disconnect two brake lines at modulator assembly.
3. Disconnect travel switch and solenoid connectors at modulator.
4. Remove solenoid and check valve assemblies with vacuum hoses attached.

(NOTE: The only serviceable components of the modulator are the check valve assembly, solenoid assembly and modulator without check valve or solenoid.)

5. Remove hood hinge.
6. Remove three screws that secure modulator to cowl and remove modulator.

b. Installation

1. Install modulator on cowl and secure with three screws.
2. Install hood hinge.
3. Install solenoid and check valve assemblies with vacuum hoses attached.
4. Connect solenoid and travel switch connectors.
5. Secure two brake lines at modulator assembly.
6. If pressure bleeding equipment is available, proceed to step 7. If not, proceed to step 13.
7. Remove master cylinder reservoir cover and seal assembly and fill both reservoirs with brake fluid.
8. Install Bleeder Adapter, J-22489-1 & J-22489-12 cables on master cylinder and connect bleeder hose to Bleeder Adapter Cover.
9. Build up pressure in bleeder and bleed system at modulator as described in steps 10 and 11.
10. Attach drain hose at bleeder fitting.
11. Back off fitting one-half turn and bleed brake fluid into a partially filled bottle of clean brake fluid until bubbles stop, then close fitting.
12. Raise car on hoist and first bleed right rear and

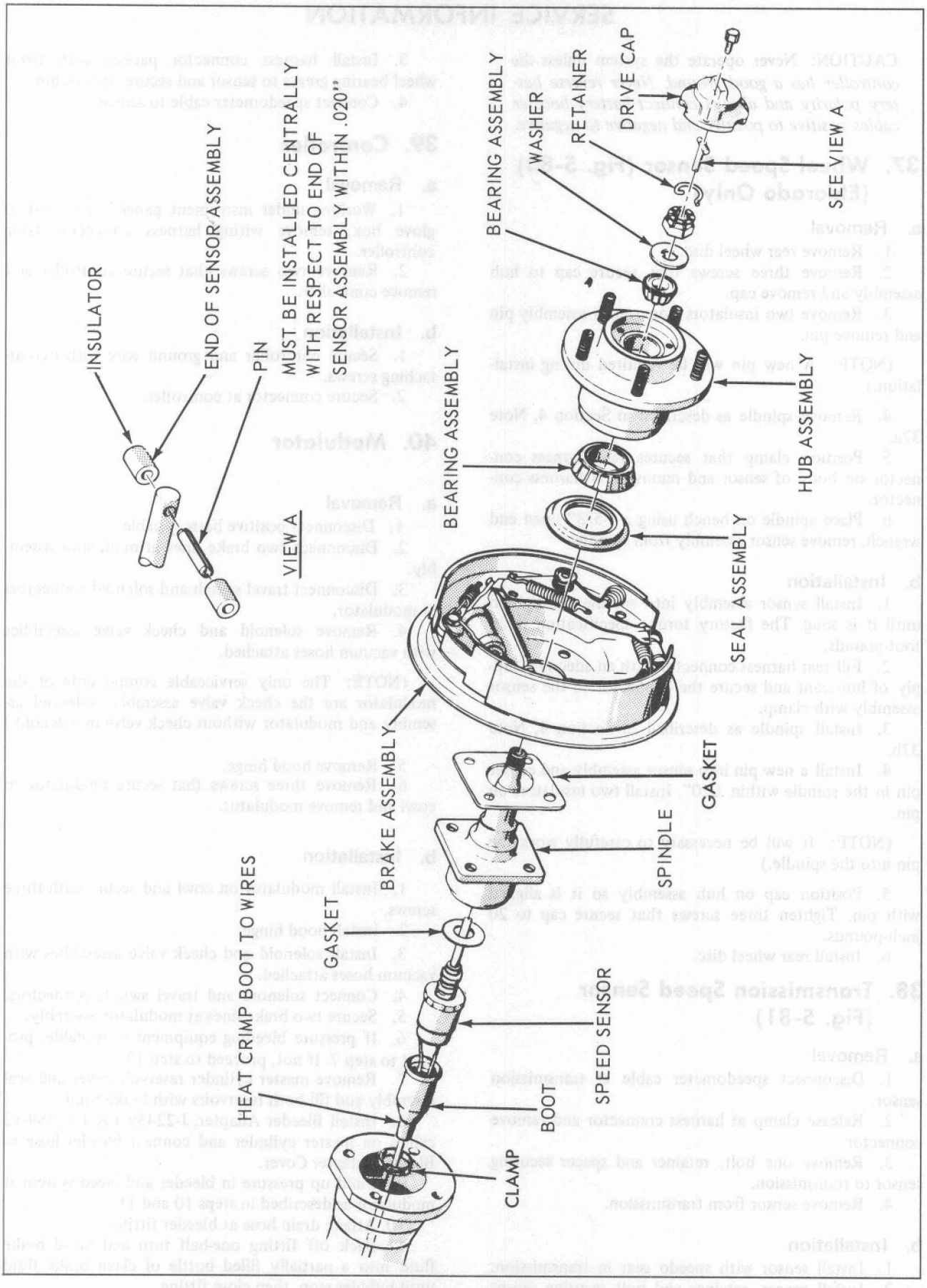


Fig. 5-80 Wheel Sensor Installation

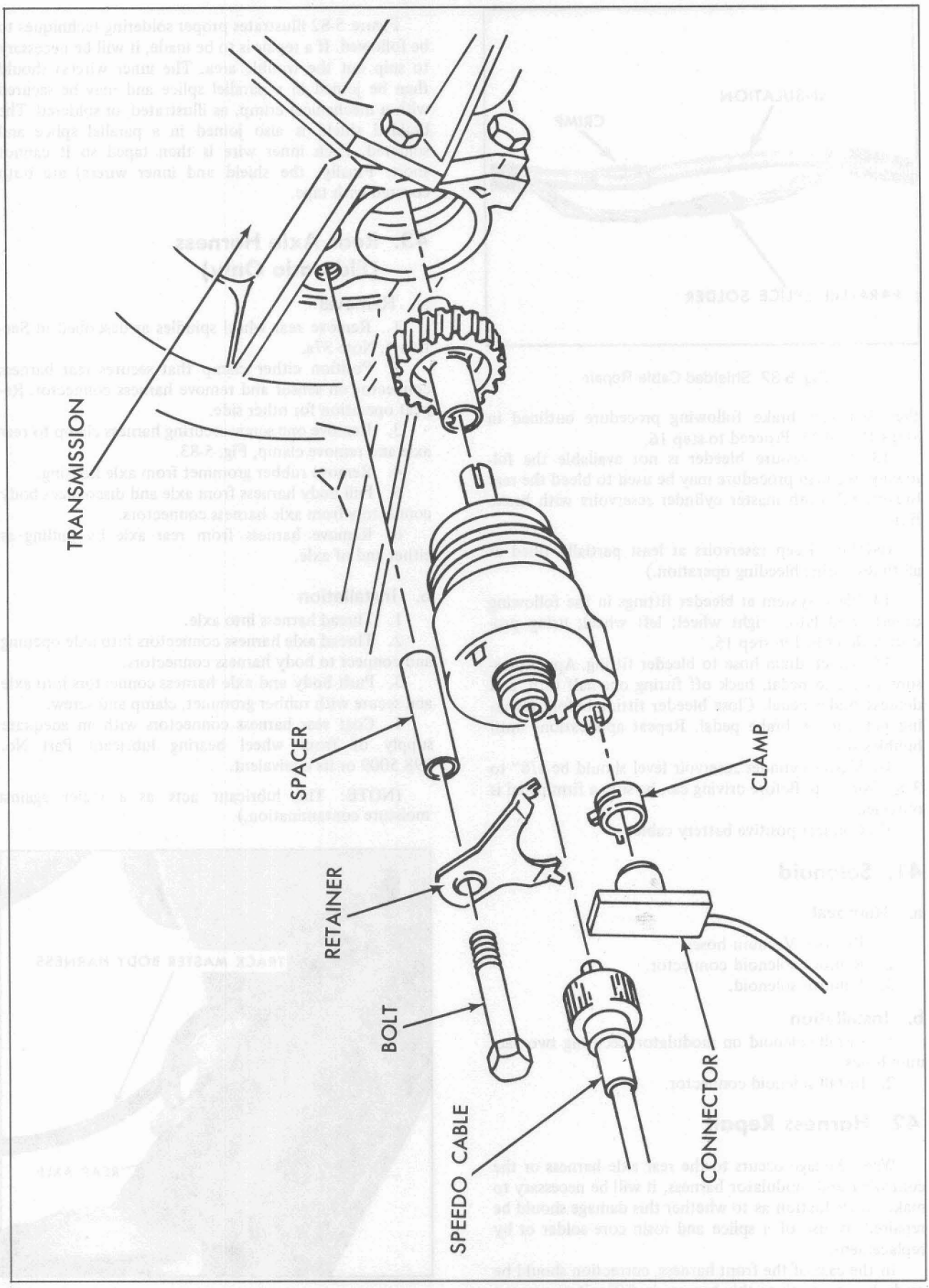


Fig. 5-81 Transmission Sensor Installation

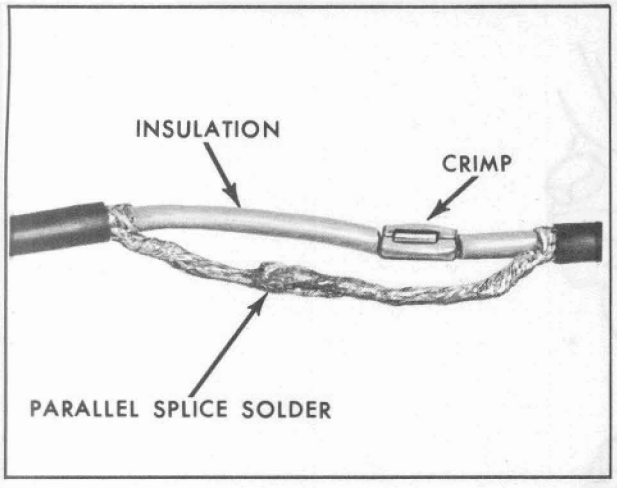


Fig. 5-82 Shielded Cable Repair

then left rear brake following procedure outlined in steps 10 and 11. Proceed to step 16.

13. If a pressure bleeder is not available the following two man procedure may be used to bleed the rear brakes. Fill both master cylinder reservoirs with brake fluid.

(NOTE: Keep reservoirs at least partially filled at all times during bleeding operation.)

14. Bleed system at bleeder fittings in the following order: modulator; right wheel; left wheel; using procedure described in step 15.

15. Attach drain hose to bleeder fitting. Apply pressure to brake pedal, back off fitting one-half turn, and depress brake pedal. Close bleeder fitting before releasing pressure on brake pedal. Repeat applications until bubbles stop.

16. Master cylinder reservoir level should be 1/8" to 3/8" from top. Before driving car, be sure a firm pedal is obtained.

17. Connect positive battery cable.

41. Solenoid

a. Removal

1. Remove Vacuum hoses.
2. Remove solenoid connector.
3. Remove solenoid.

b. Installation

1. Install solenoid on modulator, securing two vacuum hoses.
2. Install solenoid connector.

42. Harness Repair

When damage occurs to the rear axle harness or the controller and modulator harness, it will be necessary to make an evaluation as to whether this damage should be repaired by use of a splice and rosin core solder or by replacement.

In the case of the front harness, correction should be made by repair since this harness is difficult to remove and install.

Figure 5-82 illustrates proper soldering techniques to be followed. If a repair is to be made, it will be necessary to snip out the trouble area. The inner wire(s) should then be joined in a parallel splice and may be secured with a mechanical crimp, as illustrated, or soldered. The braided shield is also joined in a parallel splice and soldered. Each inner wire is then taped so it cannot short. Finally, the shield and inner wire(s) are both covered with tape.

43. Rear Axle Harness (Eldorado Only)

a. Removal

1. Remove rear wheel spindles as described in Section 4, Note 37a.
2. Position either clamp that secures rear harness connector on sensor and remove harness connector. Repeat operation for other side.
3. Remove one screw securing harness clamp to rear axle and remove clamp, Fig. 5-83.
4. Remove rubber grommet from axle housing.
5. Pull body harness from axle and disconnect body connectors from axle harness connectors.
6. Remove harness from rear axle by pulling at either end of axle.

b. Installation

1. Thread harness into axle.
2. Thread axle harness connectors into axle opening and connect to body harness connectors.
3. Push body and axle harness connectors into axle and secure with rubber grommet, clamp and screw.
4. Coat rear harness connectors with an adequate supply of front wheel bearing lubricant Part No. 998 5009 or its equivalent.

(NOTE: The lubricant acts as a sealer against moisture contamination.)

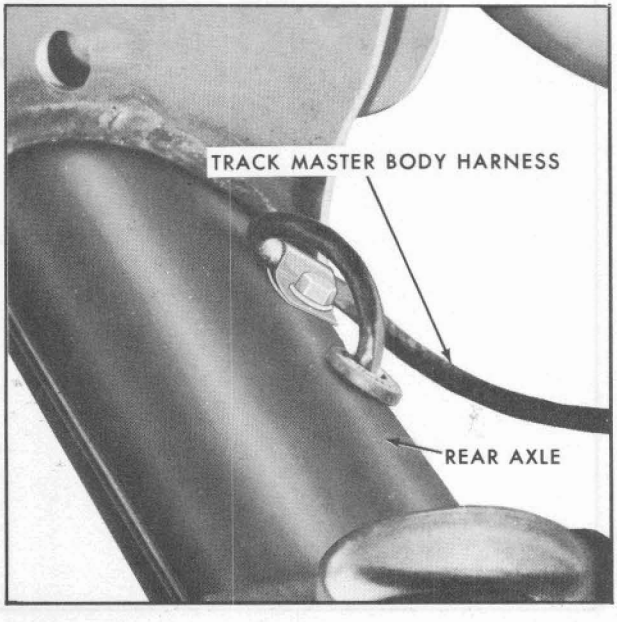


Fig. 5-83 Securing Harness to Axle—Eldorado

5. Install rear wheel spindles as described in Section 4, Note 37b.

44. Body Harness (Eldorado Only)

a. Removal

1. Disconnect body harness from controller.
2. Pull body harness out of firewall.
3. Remove one screw securing harness assembly at floor pan.
4. Remove one screw, clamp and rubber grommet securing harness to rear axle. (Fig. 5-83)
5. Remove harness connectors from rear axle and disconnect connectors from axle harness.
6. Remove harness from frame side rail by cutting plastic straps securing harness to brake line.

b. Installation

1. Install controller connector end of harness into firewall.
2. Connect to controller.
3. Thread harness along frame side rail and secure to brake line with plastic straps.
4. Connect body harness to rear axle and push connectors into rear axle.
5. Secure harness to axle with one screw, bracket and rubber grommet.
6. Install one screw securing harness to floor pan.

45. Controller and Modulator Harness

a. Removal

1. Disconnect solenoid and travel switch connectors at modulator.
2. Disconnect brown wire at underhood harness connector on left wheelhouse.
3. Remove top screw and loosen lower screw securing grommet retainer to firewall and remove split grommet. Push harness through cowl.
4. Remove upper instrument panel cover as described in Section 12, Note 40a.
5. Route harness to top of instrument panel area.
6. Disconnect single pink wire connector that leads to fuse block.
7. Disconnect four-way controller connector.
8. Remove controller and modulator harness.

b. Installation

1. Position harness on top of instrument panel area and route to pink lead to controller.
2. Connect four-way controller connector.
3. Connect single pink wire connector that leads to fuse block.
4. Route harness through cowl.
5. Connect solenoid and travel switch connectors at modulator.
6. Connect brown wire connector at underhood harness connector on left wheelhouse.
7. Install split grommet in retainer and install top screw and tighten lower screw securing grommet retainer to cowl.
8. Install upper instrument panel cover as described in Section 12, Note 40b.

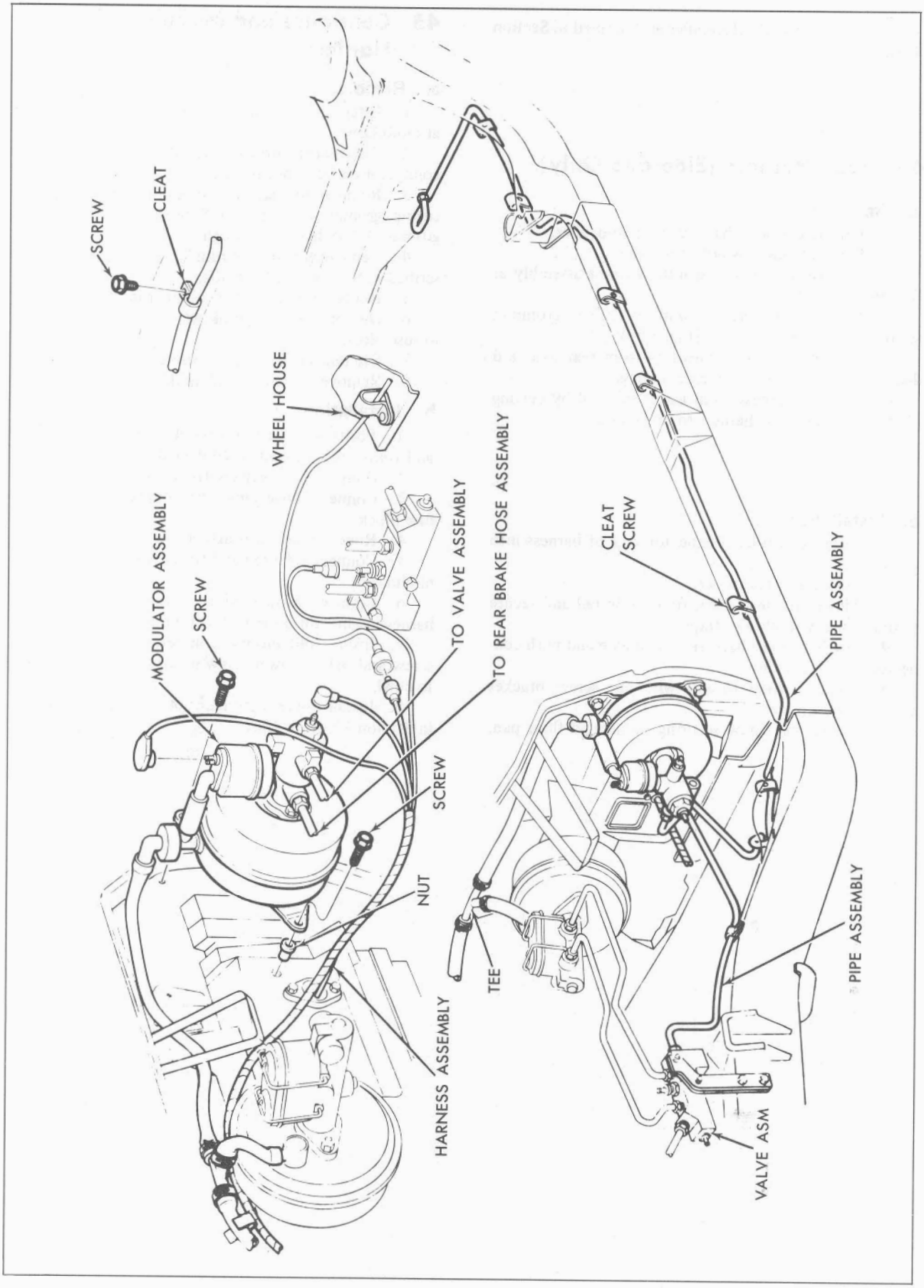


Fig. 5-84 Track Master–1

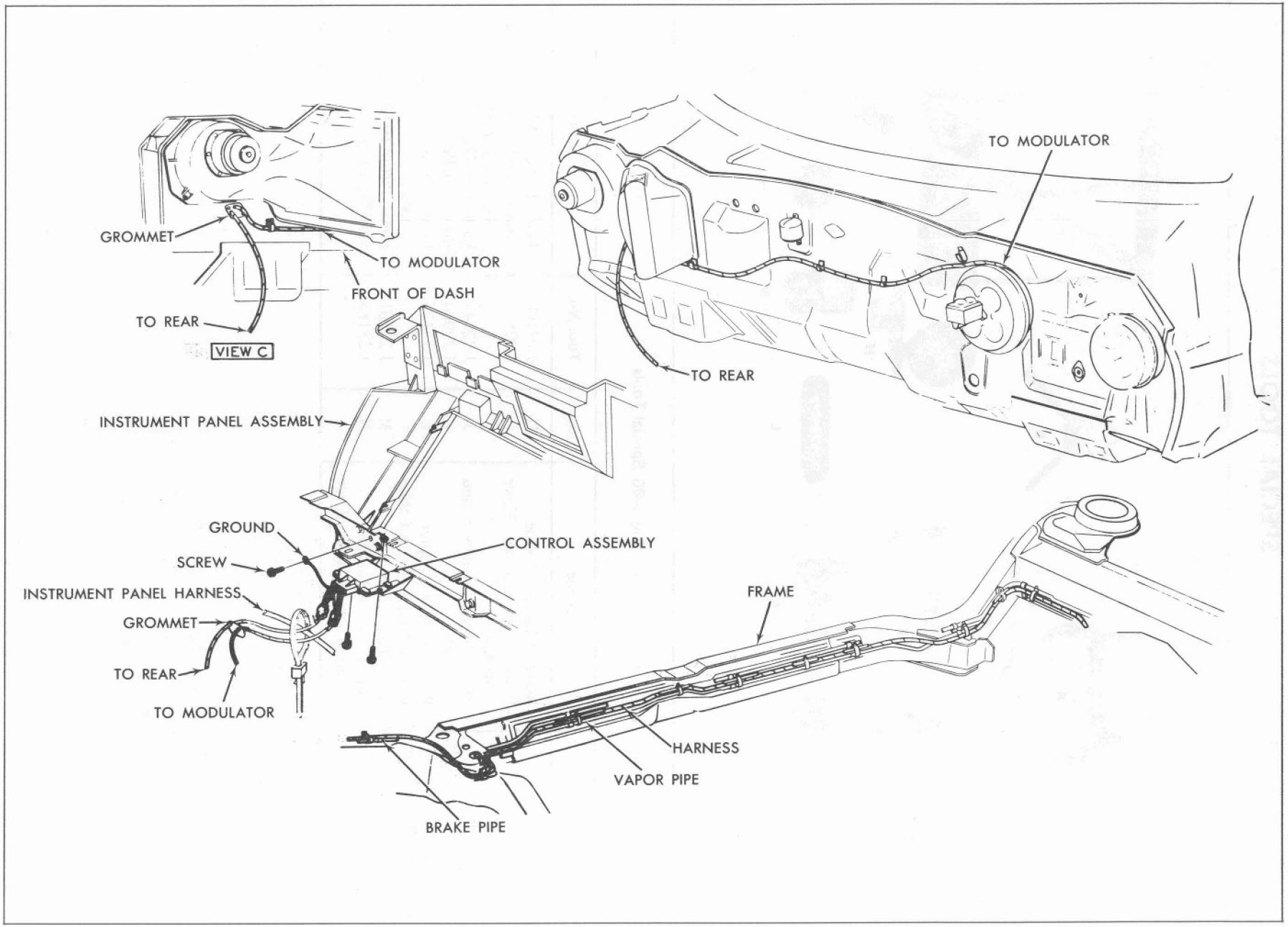


Fig. 5-85 Track Master—2

SPECIAL TOOLS

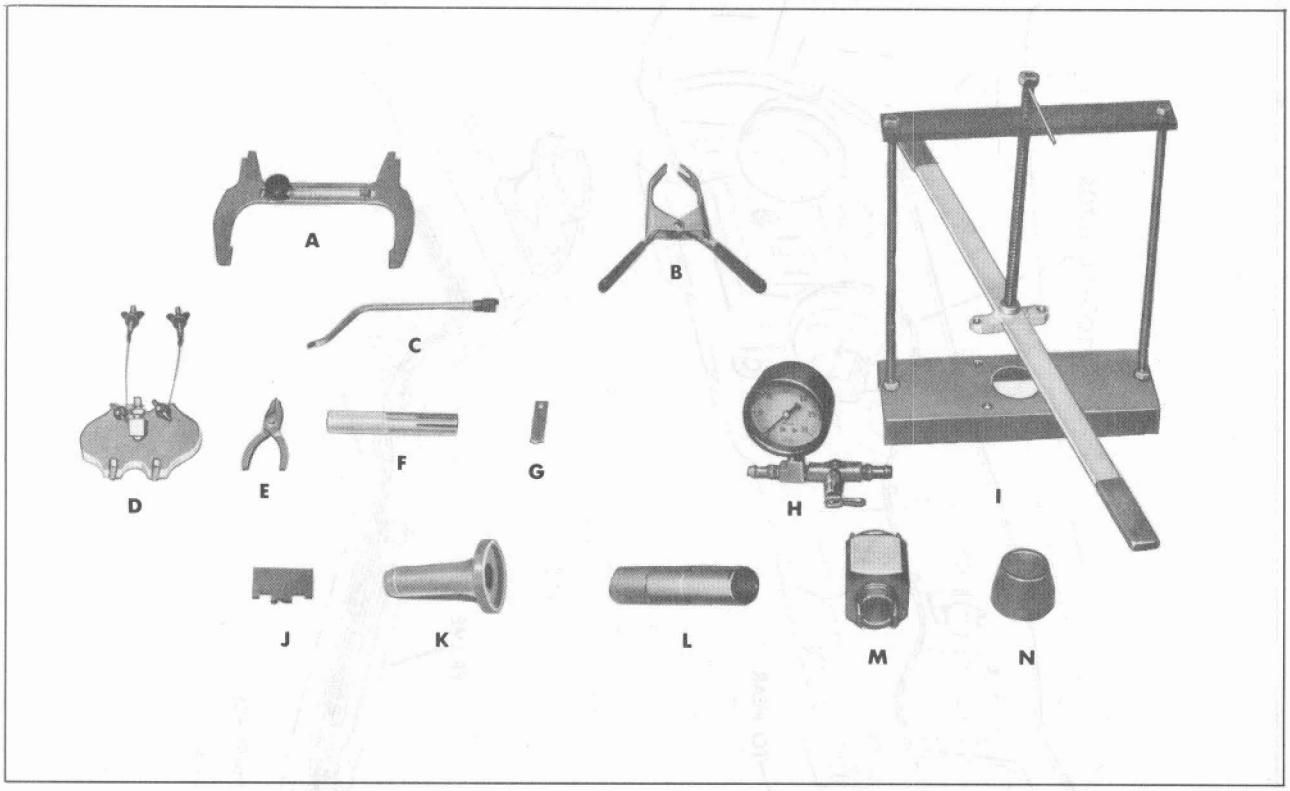


Fig. 5-86 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-21177	Brake Adjusting Caliper	H	J-23108	Leak Testing Adapter
B	J-	Brake Combination Valve Bleeder	I	J-22884	Power Unit Holding and Separating Fixture
C	J-8049	Brake Spring Remover and Installer	J	J-22647	Push Rod Gage
			K	J-22904	Boot Installer
D	J-22489-1	Brake Bleeder Adapter	L	J-23175	Control Valve Retainer Installer
	J-22484-12	Bleeder Adapter Cover Cables			
E	J-4880	Snap Ring Pliers	M	J-23101	Power Piston Holding Fixture
F	J-21601	Control Valve Installer	N	J-23188	Seal Protector
G	J-23325	Reaction Piston Height Gage			

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Engine Mechanical	6-98

DIAGNOSIS OF COOLING SYSTEM COMPONENTS

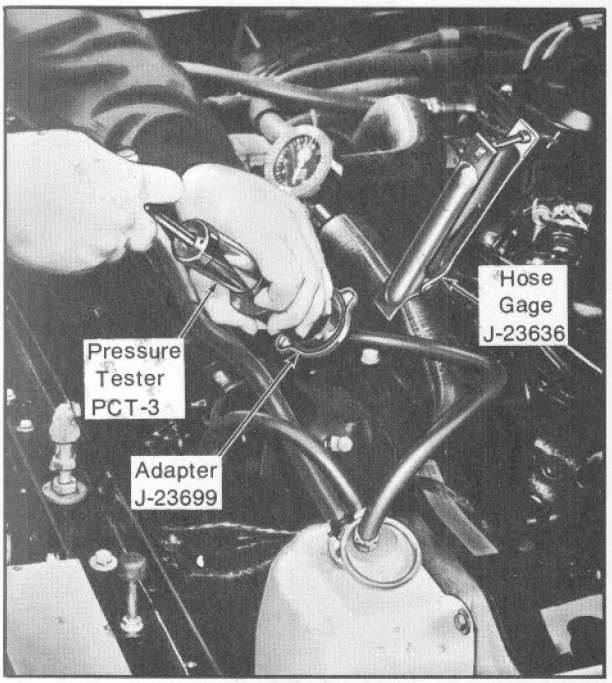


Fig. 6-1 Testing Closed Cooling System

1. Leak Testing Cooling System

1. Make visual check of hoses and hose connections for leaks. Tighten clamps as required.

2. Install hose gage, J-23636, on upper radiator hose all the way, Fig. 6-1.

3. Install adapter, J-23699, on pressure tester PCT-3.

4. Remove cap from reservoir and install pump adapter, RP-40, to hose on bottom of cap, Fig. 6-1. Secure with clamp.

5. Pump system to 16 psi and watch for a pressure drop on pump gage.

6. If pressure drops below 16 psi in 10 seconds, the spring washer gasket or filler neck nipple is leaking. If pressure does not drop, proceed to step 12.

7. Open drain valve on radiator and drain until all pressure is out of system. Close valve and proceed.

8. Remove radiator cap and check for weak spring washer or damage to gasket. Check overflow tube to filler neck for solder crack.

9. If spring washer in cap is weak, install new radiator cap. If nipple is loose or cracked, re-solder.

10. Re-install coolant and cap.

11. Re-install pump to adapter and pressurize system to 16 psi. If system holds pressure for 10 seconds, cap gasket is sealing.

12. To check cap holding pressure, remove pump from adapter with a quick turn. Quick action is necessary to close the drop valve.

13. Wiggle upper radiator hose to stabilize gage and set red washer against the movable handle.

14. After 5 minutes, wiggle hose again and note position of movable handle relative to red washer.

15. If handle has not moved more than 1/4 inch in 5 minutes, cap is holding sufficient pressure.

16. If handle has moved more that 1/4 inch, inspect for leaks. Repair as required and repeat steps 11-15.

17. If leak is not obvious, repeat steps 11 and 12. Remove adapter from bottom of reservoir cap. Insert end of hose in a glass of water below liquid level and watch for bubbles. Presence of bubbles indicates a leaking relief valve or drop valve. Proceed to Step 18.

18. If bubbles are evident, inspect radiator filler neck flanges for distortion. Straighten flanges so that they are parallel with filler neck. File top surface of filler neck to insure a flat surface and repeat step 17. Replace radiator cap or radiator if bubbles continue.

19. Remove adapter from bottom of reservoir cap hose if not done in step 17. Install reservoir cap and remove hose gage J-23636.

2. Thermostat Test

The thermostat may be checked by suspending it, with the thermostat heat control unit down, in a small pan of ethylene glycol coolant containing a thermometer. Neither the thermostat nor the thermometer should rest on the bottom of the pan because of the uneven concentration of heat at this point when the pan is heated. The thermostat valve should start to open at a temperature between 177°F and 182°F. When the coolant reaches a temperature of 202°F, the valve should be fully open (approximately 7/16 inch).

3. Testing Coolant Solutions

A hydrometer test will indicate whether ethylene glycol or water, or both, should be added to maintain the desired freezing point of the solution. The freezing point of the solution should give protection to at least -40°F, regardless of climatic conditions. This is necessary to provide adequate corrosion protection.

Some devices used for testing solutions will indicate the correct freezing point only when tested at a specific temperature. Other testers, provide thermometers and tables, indicating freezing points corresponding to readings made at various temperatures. Disregarding the temperature of the solution when testing may cause an error as large as 30°F. in determining the freezing point.

COOLING SYSTEM DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Engine overheats.	Loss of coolant.	Inspect cooling system as described in Note 1.
	Loss of system pressure.	Inspect cooling system as described in Note 1. Check hose connections and tighten as necessary.
	Belt tension too low.	Tighten belt to specification.
	Radiator fins obstructed.	Clean away bugs, leaves, etc.
	Thermostat defective.	Install new thermostat.
	Cooling system passages blocked by rust or scale.	Flush cooling system - add fresh coolant.
	Water pump inoperative.	Repair water pump as described in Note 9.
	Spark timing incorrect.	Set timing to specification.
Engine fails to reach normal operating temperature. (Cool air from heater.)	Thermostat stuck open or of incorrect heat range.	Install new thermostat of correct type and heat range.
Loss of coolant.	Leaking radiator.	Inspect cooling system as described in Note 1.
	Leaking coolant reservoir or hose.	Replace reservoir or hose.
	Loose or damaged hoses or connections.	Reseat or replace hoses or clamps.
	Water pump seal leaking.	Repair water pump as described in Note 9.
	Water pump gasket leaking.	Replace gasket.
	Radiator cap defective, or filler neck distorted.	Inspect cooling system as described in Note 1.
	Cylinder head gasket leaking.	Replace gasket.
	Improper cylinder head screw torque.	Tighten screws to 115 foot-pounds.
	Cylinder block core plug leaking.	Replace core plug.
	Cracked cylinder head or block or warped cylinder head or block gasket surface.	Resurface or replace.
	Leaking heater core.	Repair or replace core.
	Leaking heater water control valve.	Replace valve.

THEORY OF OPERATION

The cooling system on all 1972 Cadillac engines has been designed to be kept closed at all times. This has been made possible by incorporating a coolant reservoir, Fig. 6-2, that keeps the system full, indicates the need for additional coolant, and allows coolant to be added without removing the radiator cap.

A vented radiator cap is used, which allows the coolant to expand through the normally open vent valve in the center of the cap without building unnecessary pressure. The expanding coolant flows into the coolant reservoir. The vent valve closes when the temperature of the coolant nears the boiling point and pressure is needed to control boiling. The nominal 15 pound pressure will not be reached until the system is working at maximum capacity.

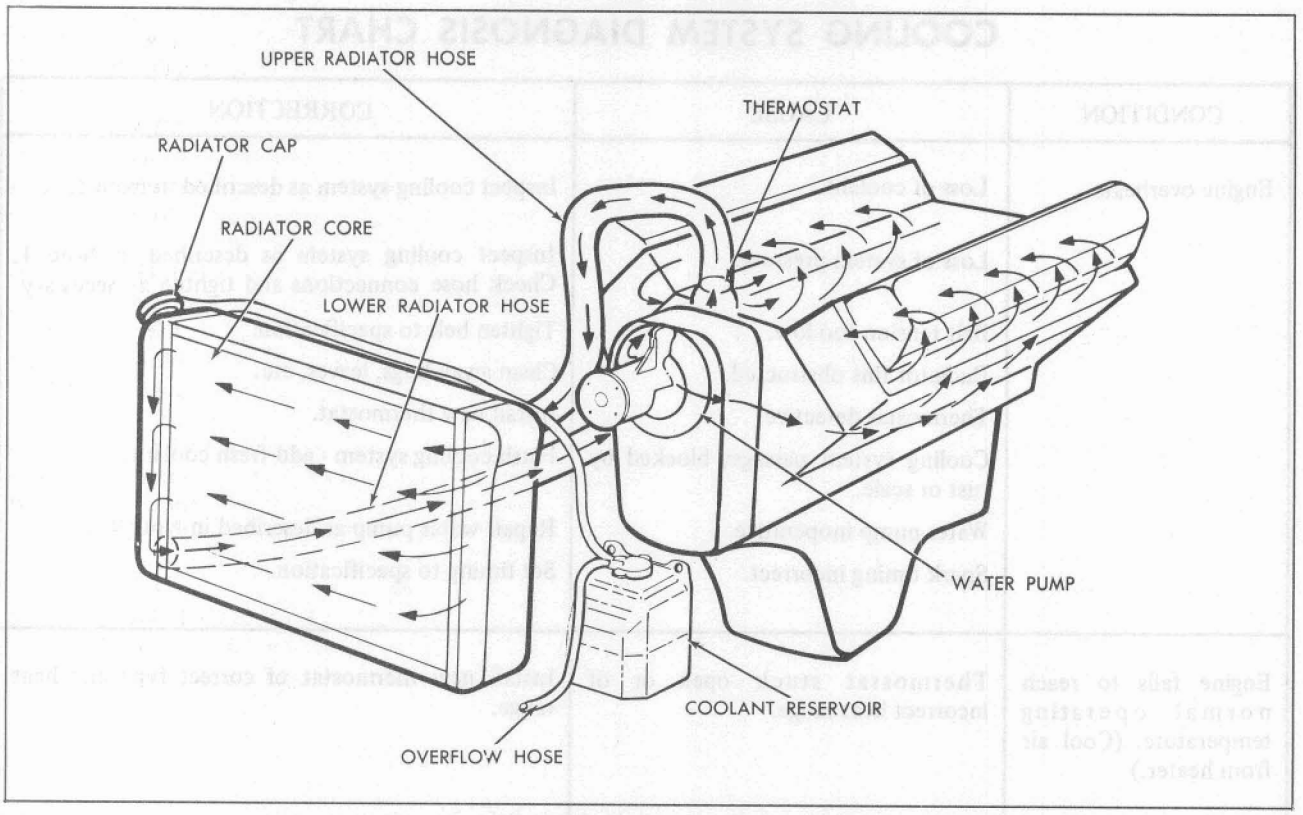


Fig. 6-2 Flow of Coolant

Any air or vapor in the cooling system will be forced to the coolant reservoir under the liquid level and leave through the vent tube at the top of the reservoir. As the system cools, the extra coolant in the reservoir will be drawn back to the radiator through the vent valve. In this manner, the radiator will keep itself full at all times. The need for additional coolant can be detected by observing the level of coolant in the reservoir while the engine is at normal operating temperature.

A seven-bladed flexible fan is used on all 1972 cars. The fan is constructed so that, as engine speed increases, the blades tend to flatten out and decrease their pitch. This allows the fan to pull less air through the radiator at high engine speeds, as it is not needed because of the normally increased flow due to vehicle motion. The Eldorado and all cars with heavy duty cooling use a seven-bladed fan of similar design but with a more radical blade curvature for increased air flow at idle.

If a fan blade is bent or damaged in any way, no attempt should be made to repair and reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new fan assembly.

It is essential that fan assemblies remain in proper balance and proper balance cannot be assured once a fan assembly has been bent or damaged. A fan assembly that is not in proper balance could fail and fly apart during subsequent use creating an extremely dangerous condition.

A cast iron water pump is mounted at the front of the engine. It is driven by a "V" belt and may be serviced as described in Note 9.

Coolant is pumped to each bank of cylinders simultaneously, then through passages to the cylinder heads, through the thermostat housing at the top of the cylinder block to the left hand radiator tank. Radiator coolant flow is from the left hand tank through the core to the right hand tank, which is the source of coolant to the water pump inlet, Fig. 6-2.

When the thermostat is closed, coolant from the cylinder heads is pumped through a by-pass passage below the thermostat housing to the water pump and recirculated. When the engine is sufficiently warm, the thermostat opens and coolant flows to the inlet tank on the left side of the radiator, and is cooled as it flows across the horizontal core tubes to the outlet tank on the right side of the radiator, completing the cycle.

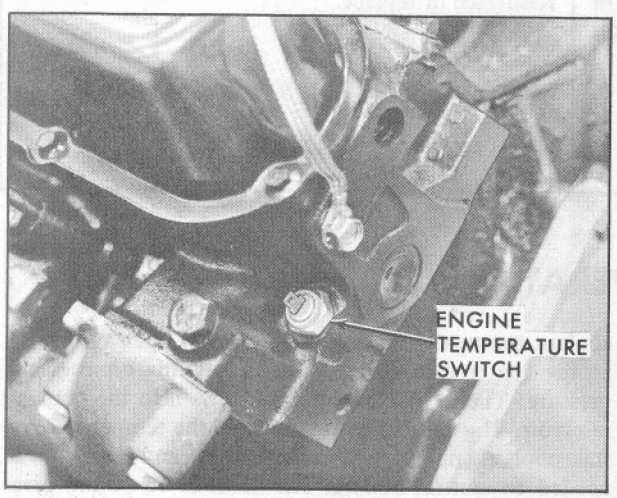


Fig. 6-3 Engine Metal Temperature Switch

A thermo-vacuum valve is used on all 1972 Cadillac cars. The valve is located in the front of the cylinder block just under the left cylinder head. It has three fittings, one to manifold vacuum, one to carburetor vacuum above the throttle valve and one to the distributor vacuum diaphragm. At coolant temperatures above 220°F, this valve switches from carburetor vacuum to manifold vacuum, advancing the ignition timing to full vacuum advance at idle. This reduces the possibility of engine overheating under extremely high temperature operation.

The transmission oil cooler is located in the outlet tank on the right side of the radiator.

The water temperature tell-tale light is located in the lower right portion of the warning light cluster at the right side of the speedometer (Fig. 12-21). The light reads "WATER" and will glow red whenever coolant temperature becomes excessive. The light is activated by a temperature sensitive switch in the water passage directly below the air conditioning compressor. To check operation of the "WATER" tell-tale light, turn the ignition switch to the "start" position. The light should glow. As soon as the engine is started, the light should go out.

In addition to the water temperature warning light, an engine metal temperature warning light and buzzer system is used on all 1972 Cadillacs.

The tell-tale light to the left of the "WATER" indicator (Fig. 12-21) is a red light that reads "STOP ENG-TEMP". It will light whenever engine metal temperature is excessive. In addition to the glowing lamp, the anti-theft buzzer will sound.

The engine metal temperature switch (Fig. 6-3), located at the rear of the left cylinder head senses the temperature of the casting rather than the temperature of the coolant. The switch screws into a blind hole in the cylinder head, so sealer must not be used when installing this switch.

The high engine temperature warning system does not utilize the ignition switch ground circuit as do the other tell-tale lights. Therefore, the red "STOP ENG-TEMP" light should not glow when the ignition switch is in the "ON" position.

Operation of the "STOP ENG-TEMP" light is checked by opening the drivers door while key is in "Lock" or "Off" position. Light should glow and buzzer should sound.

SERVICE INFORMATION

4. Cooling System Preventive Maintenance

Regardless of climate, the cooling system should be drained, flushed with water only, and refilled every 24 months or 24,000 miles, whichever occurs first, with a 50-50 mixture of water and an ethylene glycol base coolant to protect the engine to at least -40°F. Check all hose connections whenever ethylene glycol base coolant is changed. These measures are necessary to retard corrosion, rust and scale, keep water passages open, seal against internal or external leakage and give the earliest possible indication of trouble.

(NOTE: Supplemental inhibitors or additives claiming to provide increased cooling capability that have not been specifically approved by GM are not recommended for addition to the cooling system. These additives may be detrimental to the efficient operation of the system, and they represent an unnecessary operating expense.)

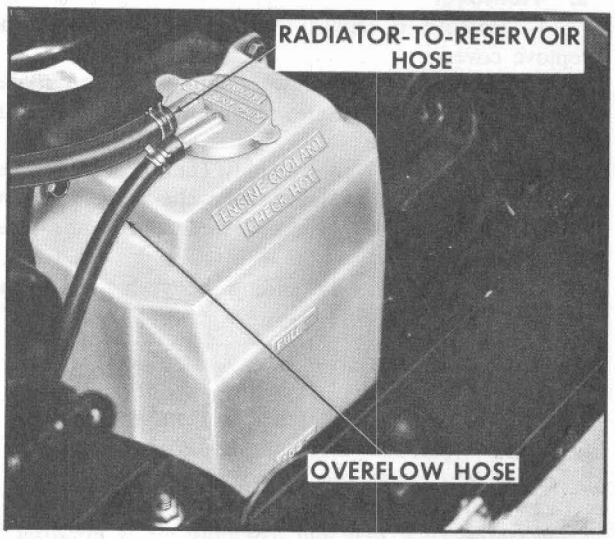


Fig. 6-4 Coolant Reservoir

Check coolant level in reservoir at each engine oil change. The coolant reservoir is marked "FULL" and "ADD", Fig. 6-4. These marks are approximately two quarts apart so that one quart of ethylene glycol and one quart of water can be added. The reserve above the full mark is to allow for expansion while parked after hot running. The coolant level should be between the "FULL" and "ADD" marks at normal operating temperature. The level may be observed below the "ADD" mark when the system cools below operating temperature.

5. Radiator Filler Cap Removal

WARNING: IF THERE IS EVIDENCE OF STEAM, DO NOT OPEN HOOD UNTIL STEAM IS DISPERSED.

The radiator cap, Fig. 6-5, should only be removed during engine draining, addition of coolant because of

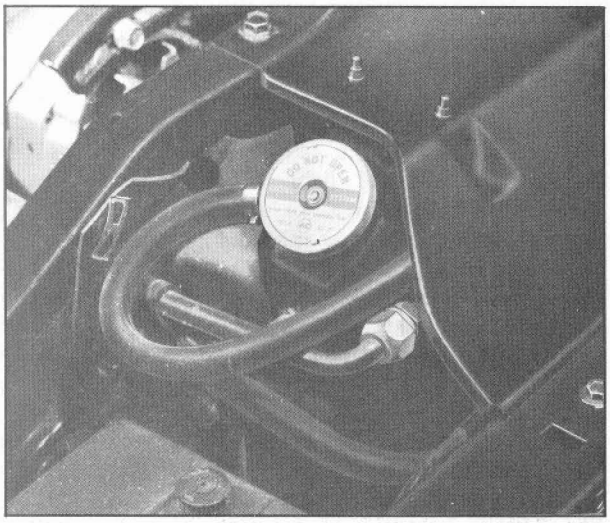


Fig. 6-5 Radiator Cap

coolant in the reservoir, or when coolant has not been moving in and out of the reservoir.

6. Cooling System Flushing Procedure

1. Drain coolant from cooling system by opening radiator drain cock and removing two drain plugs from cylinder block. If coolant side of radiator cap is rusty, flush system twice.

2. After the drain points have been closed, refill system with fresh water only and install radiator cap. Set defroster lever to "DEF" position and turn temperature to 85°. This opens the water control valve and allows the water to pass through the heater core.

(NOTE: On Fleetwood Seventy-Five sedans and limousines, also turn rear heater system on and rotate temperature dial to 85°.)

3. Run engine at medium speed for one-half hour at a temperature as hot as possible without boiling. Cover one-half the radiator if necessary.

4. Inspect the following points in the cooling system:

a. Radiator core for leaks.

b. Radiator air passages for plugging caused by bugs, leaves, etc.

c. Condition and tension of drive belts, as described in Note 10.

d. Condition of hoses and tightness of clamps.

5. Drain system by opening all drains. If flush water has a rust color, repeat procedure.

6. After the drain points have been closed, add equal amounts of ethylene glycol base coolant and water to protect engine to at least -40°F.

(NOTE: Supplemental inhibitors or additives claiming to provide increased cooling capability that have not been specifically approved by GM are not recommended for addition to the cooling system. These additives may be detrimental to the efficient operation of the system, and they represent an unnecessary operating expense.)

7. With the radiator cap removed and heater controls on maximum as outlined in step 2, run engine with throttle set on fast idle cam for 10 minutes. Add coolant until the radiator is completely full and tighten radiator cap before stopping engine.

8. Check coolant level in the reservoir and add coolant as necessary to bring level up to the "FULL" mark.

9. Deterioration of the hoses in the engine compartment takes place over a period of time due to the exposure to high temperatures in this environment. To protect the engine from damage due to coolant loss, the hoses and clamps in the engine cooling and heater systems should be replaced after two years of service or after 24,000 miles, whichever occurs first.

7. Thermostat

a. Removal

1. Drain radiator until coolant level is below level of thermostat housing.

2. Disconnect upper radiator hose at thermostat housing.

3. Remove two screws securing thermostat housing to cylinder block and remove housing. Discard gasket.

4. Remove thermostat from cylinder block.

b. Installation

1. Install thermostat in opening at top of cylinder block with valve up.

2. Position a new gasket coated with gasket cement on cylinder block.

3. Install thermostat housing on cylinder block and secure with two screws. Tighten screws to 10 foot-pounds.

4. Connect upper radiator hose to thermostat housing.

5. Fill cooling system to proper level.

8. Fan Blade

a. Removal

1. Remove 6 screws securing radiator cover and remove cover.

2. Unthread four screws holding fan and spacer to water pump hub. Screws cannot be removed due to radiator clearance.

3. Move entire fan assembly (fan, spacer, screws) away from hub to a point near the power steering pump and remove the screws and spacer now that space permits.

4. Remove fan, by sliding between cradle and radiator.

b. Installation

CAUTION: If a fan blade is bent or damaged in any way, no attempt should be made to repair and reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new fan assembly. It is essential that fan assemblies remain in proper balance

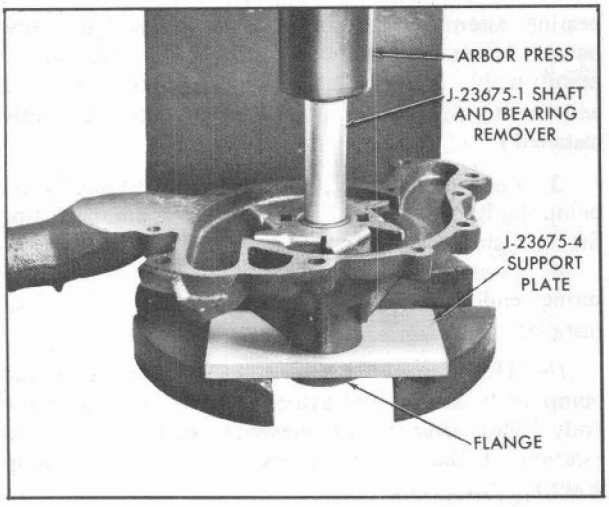


Fig. 6-6 Disassembling Water Pump

and proper balance cannot be assured once a fan assembly has been bent or damaged. A fan assembly that is not in proper balance could fail and fly apart during subsequent use creating an extremely dangerous condition.

1. Slide fan between radiator cradle and radiator and temporarily position near power steering pump.
2. Insert four screws through fan and spacer.
3. Make sure mounting holes in water pump pulley line up with threaded holes in water pump hub.
4. Position fan assembly to water pump hub and tighten screws to 18 foot-pounds.
5. Position radiator cover and secure with 6 screws.

9. Water Pump Overhaul

(NOTE: Some water pumps may have a greenish coolant stain at the vent hole below the shaft. This is a normal condition. The water pump should not be serviced unless it is obviously leaking with the engine running (either hot or cold) and under pressure.)

a. Removal

1. Disconnect negative battery cable.
2. Drain radiator.
3. Remove fan assembly as described in Note 8a.
4. Loosen generator mounting screws and remove generator belt.
5. Loosen power steering pump mounting screws and remove power steering pump belts.
6. Remove water pump pulley from water pump shaft.
7. Disconnect water inlet from water pump.
8. Remove 11 screws securing water pump to engine front cover and remove pump. Discard gasket and clean gasket surfaces.

b. Disassembly

1. Position Support, J-23675-4, around shaft of water pump between pump body and flange so that water pump casting fits in slight recess, Fig. 6-6.
2. Position pump impeller-side-up, in arbor press so that shaft and bearing assembly is free to move when pressed.
3. Position J-23675-1 on impeller side of shaft and press shaft and bearing assembly and impeller hub through impeller, pump body and out front of pump, Fig. 6-6.
4. Remove special tools and remove impeller from pump body.
5. Discard all parts except pump body, Fig. 6-7.

c. Assembly

1. Position Bearing Locator, J-23675-3, into rear of pump and place pump, face up, in arbor press, Fig. 6-8.

(NOTE: Locator, J-23675-3, determines depth that bearing is installed in water pump body. The body rests on the lower step and bearing outer race bottoms against the upper step upon installation of the bearing.)

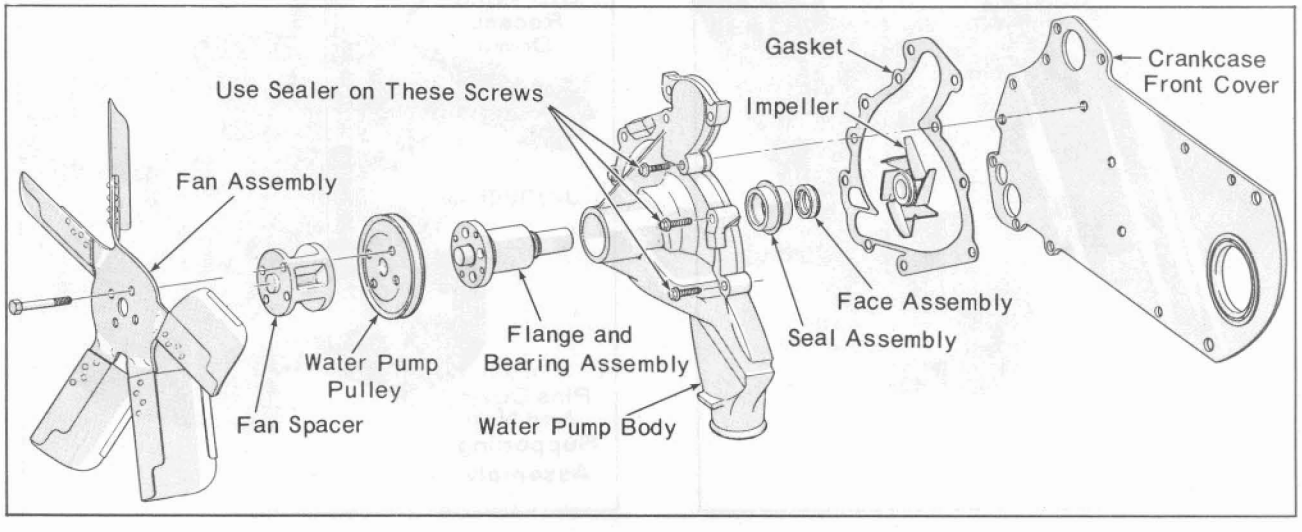


Fig. 6-7 Water Pump Disassembled

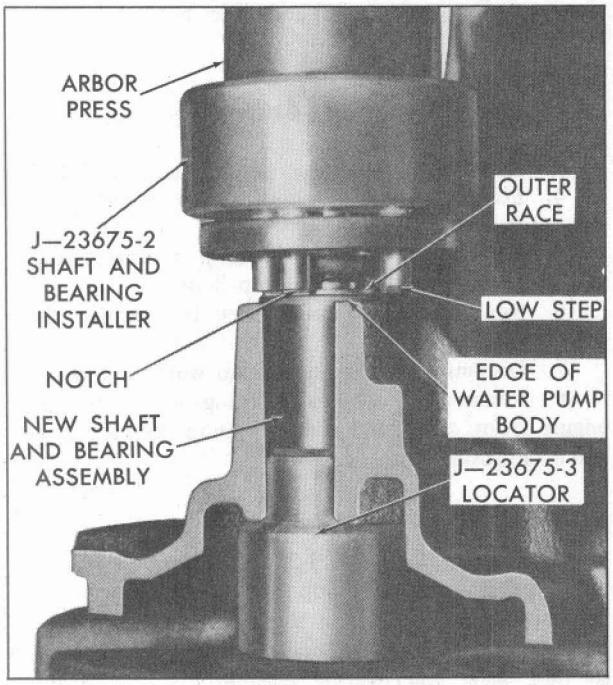


Fig. 6-8 Installing Shaft and Bearings

2. Using Tool J-23675-2, press shaft and bearing into pump until bearing outer race bottoms on Locator J-23675-3, Fig. 6-8.

(NOTE: If a hydraulic press is used, care should be exercised not to exert excessive pressure on the pins of J-23675-2. If available, a press without hydraulic assist is best used for this job.

Installer J-23675-2, acts only as an installer, not as a gage. The notches on the pins of J-23675-2 accommodate production variations of the flange and bearing assembly and water pump body. On a few pumps, outer race of bearing may be below water pump body. However, the low steps of J-23675-2 will never touch the pump body when correctly installed.)

3. Position support, J-23675-4, between water pump body and flange, so that water pump casting fits in slight recess, Fig. 6-9.

4. Position new seal assembly over shaft with spring end up and press into position using Seal Installer, J-8999-9, Fig. 6-9.

(NOTE: Support Plate, J-23675-4, supports the pump body as the seal assembly is seated against the body. This arrangement prevents an accidental dislocation of the bearing in its relation to the pump body.)

5. Dip ceramic seal in ethylene glycol before installing over shaft. Install ceramic seal and drive rubber over shaft with ceramic side down.

6. Position bearing installer, J-23675-2, with pins down and not supporting assembly into cut out section of support plate, J-23675-4, and position shaft on flange into hole in J-23675-2, Fig. 6-10.

7. Position impeller vanes down, over shaft and exactly center recess of J-23675-1 on impeller hub, Fig. 6-10. Press impeller into position until tool bottoms on shaft.

(NOTE: J-23675-1 positions the impeller so the shaft is .010"-.020" above impeller hub. This aligns the impeller so the blades will not strike the engine front cover. When installing the impeller, shaft is

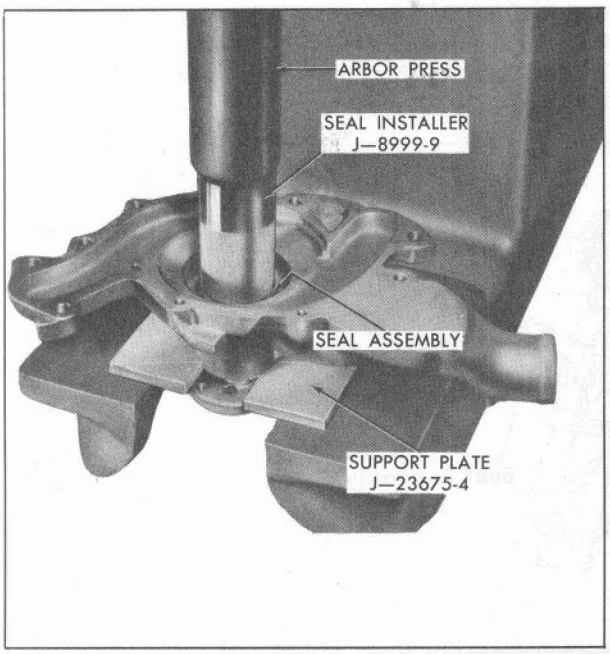


Fig. 6-9 Installing Shaft Seal

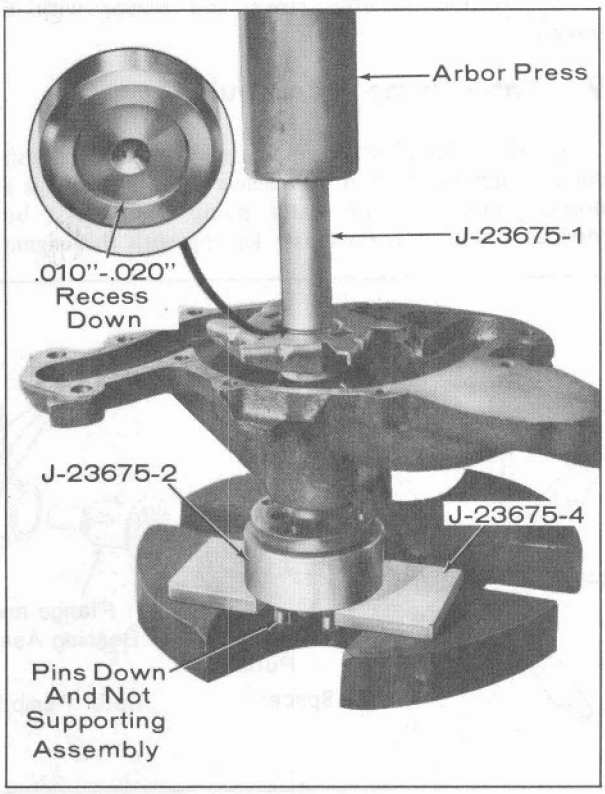


Fig. 6-10 Installing Impeller

supported on its ends by J-23675-1 and J-23675-2. This arrangement prevents an accidental dislocation of the bearing in its relation to the pump body.)

8. Check to see that impeller does not strike engine front cover upon installation. This may be done by placing a straight edge across the body and rotating the impeller. Shaft and impeller blades should clear the straight edge.

9. If blades clear, install pump on car. If the blades do not clear, the following corrective action may be taken.

10. Repeat steps 6 and 7 and check for impeller clearance. Also, if blades do not stick out past the body excessively, the engine front cover gasket may provide the necessary clearance.

11. If step 10 does not correct problem, an attempt may be made to relocate the impeller hub. Position Bearing Installer, J-23675-2, with pins down and not supporting assembly, into cut out section of Support Plate, J-23675-4. Position shaft on flange into hole in J-23675-2, Fig. 6-11. Center a ¾" socket on impeller hub and insert .060" feeler gage between pump body and impeller blade. Carefully press impeller hub until correct clearance is obtained. Specification between body and blade is .030" to .060".

CAUTION: Do not press too far or rebuilt pump will be ruined.

d. Installation

1. Position new gasket on water pump flange.
2. Position pump on engine, lining up holes in pump with holes in engine front cover, and install eleven screws with sealer as indicated in Fig. 6-12.
3. Connect water inlet hose to pump.
4. Position water pump pulley on pump.
5. Loosely install all drive belts.

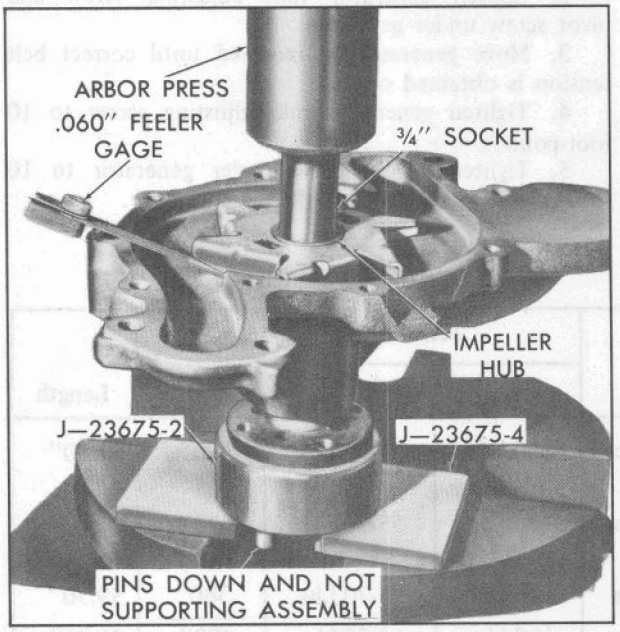
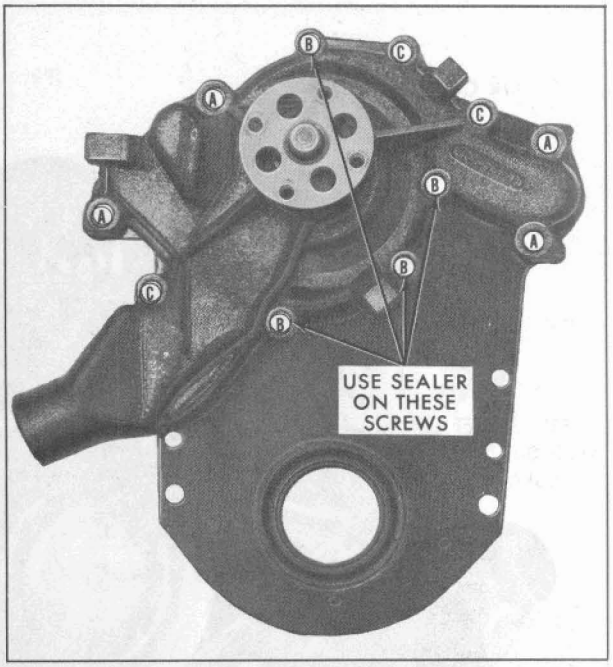


Fig. 6-11 Gaging Impeller



Key	No.	Size	Torque
A	(4)	3/8 - 16 x 1-3/8	22 foot-pounds
B	(4)	1/4 - 20 x 1-1/8	70 inch-pounds
C	(3)	5/16 - 18 x 1-1/4	15 foot-pounds

Fig. 6-12 Water Pump Assembly Attaching Screws

6. Install fan assembly as described in Note 8b.
7. Tension all drive belts as described in Note 10.
8. Fill cooling system to proper level with ethylene glycol base coolant as described in Note 1.
9. Reconnect negative battery cable.
10. Run engine and check for leaks.

10. Belt Adjustments

a. Checking Drive Belts

1. Drive belts should be checked for signs of unusual wear, cuts and fraying. Worn belts should be replaced.

2. On dual belt arrangements, such as the power steering pump belts, if it is necessary to replace one belt, replace both belts to equalize tension on both belts.

3. Place Belt Tension Gage, J-23600 midway between pulleys on drive belt being checked, locations A, B, C or D indicated in Fig. 6-13.

4. Check gage reading for belt being checked. Proper belt tension is shown in the table on page 6-10. If belt tension is incorrect, adjust specific belt according to the corresponding procedure described in b, c or d of this note.

(NOTE: A belt that has been previously tensioned is considered a used belt. A belt that has never been tensioned is considered a new belt.)

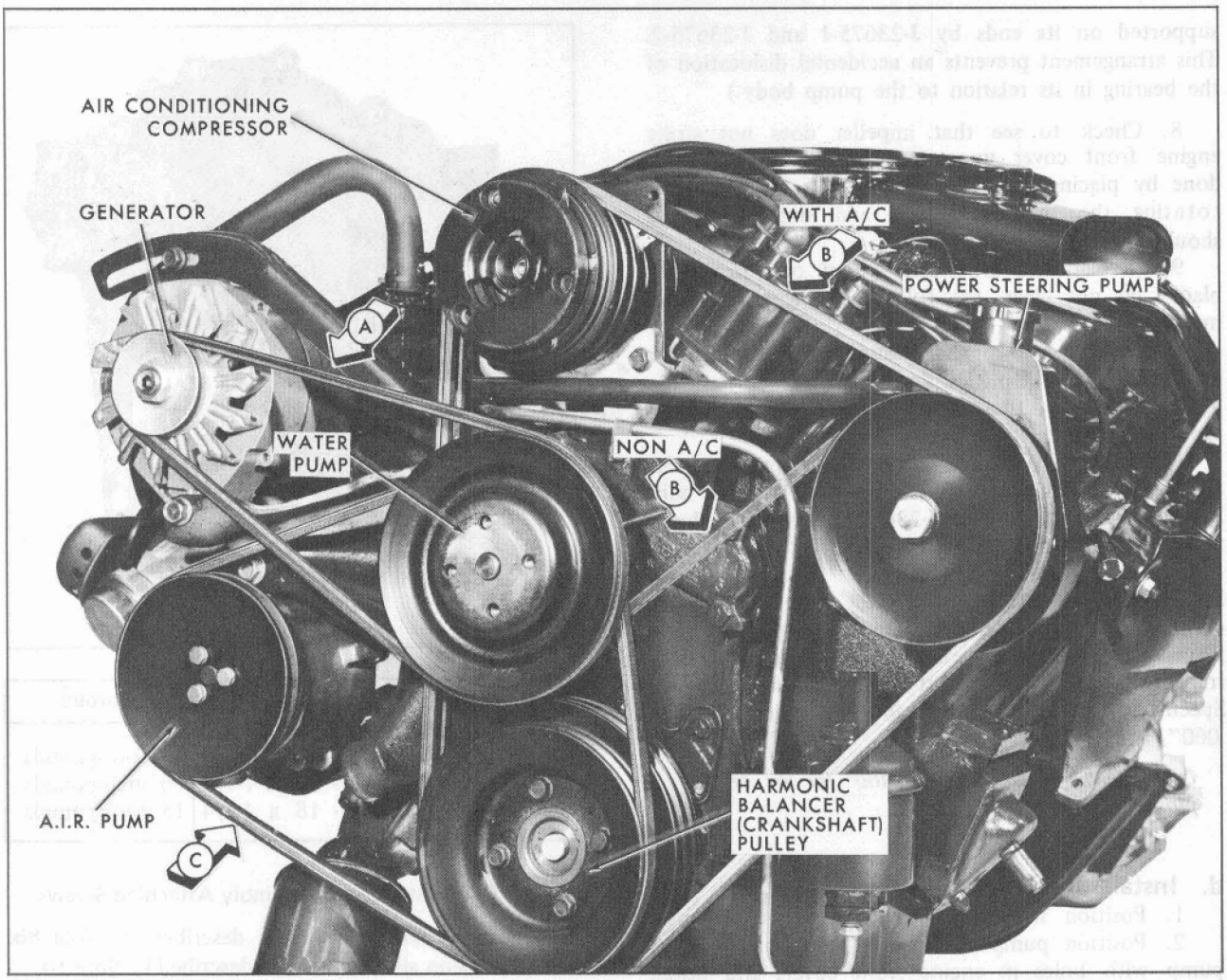


Fig. 6-13 Belt Tensioning

5. If after tensioning, a belt fails to maintain 55 foot-pounds tension, it should be replaced.

b. Generator Belt Tension

1. Place Belt Tension Gage, J-23600 on drive belt midway between pulleys at location A in Fig. 6-13.

2. Loosen generator link adjusting screw and pivot screw under generator.

3. Move generator as required until correct belt tension is obtained on gage.

4. Tighten generator link adjusting screw to 10 foot-pounds.

5. Tighten pivot screw under generator to 10 foot-pounds and remove Belt Tension Gage.

Belts	Number of Belts Used	Type	Tension		Width	Length
			New	Used		
Generator	1	38° Wedge	100 Lbs.	55-70 Lbs.	.470"	37.50"
Power Steering Pump (Non-Air Conditioned Cars)	1	38° Wedge	100 Lbs.	55-70 Lbs.	.470"	48.00"
Power Steering Pump and Air Conditioning Compressor	2	38° Wedge	100 Lbs.	55-70 Lbs.	.380"	59.50"
A.I.R. System Air Pump	1	38° Wedge	100 Lbs.	55-70 Lbs.	.470"	45.25"

c. Power Steering Pump and/or Air Conditioning Compressor Belt Tension

1. Place Belt Tension Gage, J-23600 on drive belt midway between pulleys at location "B" or "C", shown in Fig. 6-13.
2. Loosen, (1) steering pump adjusting nut at top of pump mounting bracket, (2) lower adjusting slot bolt and (3) pivot bolt.
3. Move power steering pump as required until correct belt tension is obtained on gage.
4. Snug lower adjusting slot bolt.
5. Snug lower pivot bolt.
6. Snug upper adjusting slot nut.
7. Tighten lower adjusting slot bolt to 22 foot-pounds.
8. Tighten lower pivot bolt to 22 foot-pounds.
9. Tighten upper adjusting slot nut to 22 foot-pounds.

d. A.I.R. Pump Belt Tension

1. Raise front of car.
2. Loosen A.I.R. pump pivot bolt.
3. Place Belt Tension Gage, J-23600, on drive belt midway between pulleys at location D in Fig. 6-13.
4. Loosen A.I.R. pump adjuster link screw below pump.
5. Move A.I.R. pump as required until correct belt tension is obtained on gage.

CAUTION: To avoid internal damage, pry as close to rear of pump cover as possible, near dowel pin.

6. Tighten adjuster link screw.
7. Tighten pivot screw and remove Belt Tension Gage.
8. Lower car.

SPECIFICATIONS

Fan	
Number of Blades	7
Hoses	
Type	Reinforced Molded
Thermostat Housing to Radiator Inlet (Top)	Diameter Inside 1.50"
Radiator to Water Pump Inlet (Bottom)	Diameter Inside 1.50"
Thermostat	
Starts to Open	177°F. to 182°F.
Fully Open (Approximately 7/16")	202°F.
Drive Belt Ratios	
Water Pump	1.24 to 1
Generator—Except Heavy Duty	3.21 to 1
Generator—Heavy Duty	2.28 to 1
Power Steering Pump	1.26 to 1
Air Conditioning Compressor	1.48 to 1
A.I.R. Pump	1.20 to 1
Capacity of System*	
with Heater	21.3 Qts.
with Air Conditioning	21.8 Qts.
Seventy-Five Series	24.8 Qts.
Area of Core	480 Sq. In.
Core Depth	
Non-Air Conditioned Car	1.26 In.
Air Conditioned Cars	1.98 In.
with Heavy Duty Cooling	2.70 In.
Core Center Constant	
Except Eldorado w/Air Conditioning	.16 In.
Eldorado w/Air Conditioning, All Cars w/Heavy Duty Cooling	.14 In.
Tubing Spacing	.55 In.
Radiator Cap Pressure	13.5 to 16.5 psi

*On Cars with Heavy Duty Cooling, Add 2 Quarts.

TORQUE SPECIFICATIONS

Material Number	Application	Size	Torque
280M	Fan Blade Assembly Mounting Screw	5/16-24	18 Ft. Lbs.
1010	Heater Hose Clamp	10-24	13 In. Lbs.
280M	Thermostat Housing Screw	5/16-18	10 Ft. Lbs.
260M	*Water Pump to Cylinder Block Screw	3/8-16	22 Ft. Lbs.
260M	*Water Pump to Cylinder Block	5/16-18	15 Ft. Lbs.
260M	*Water Pump to Front Cover Screw	1/4-20	70 In. Lbs.
	*Refer to Fig. 6-12 for proper screw location.		

NOTE: Refer to back of manual, Page 16-1 for nut and bolt markings and Steel Classifications.

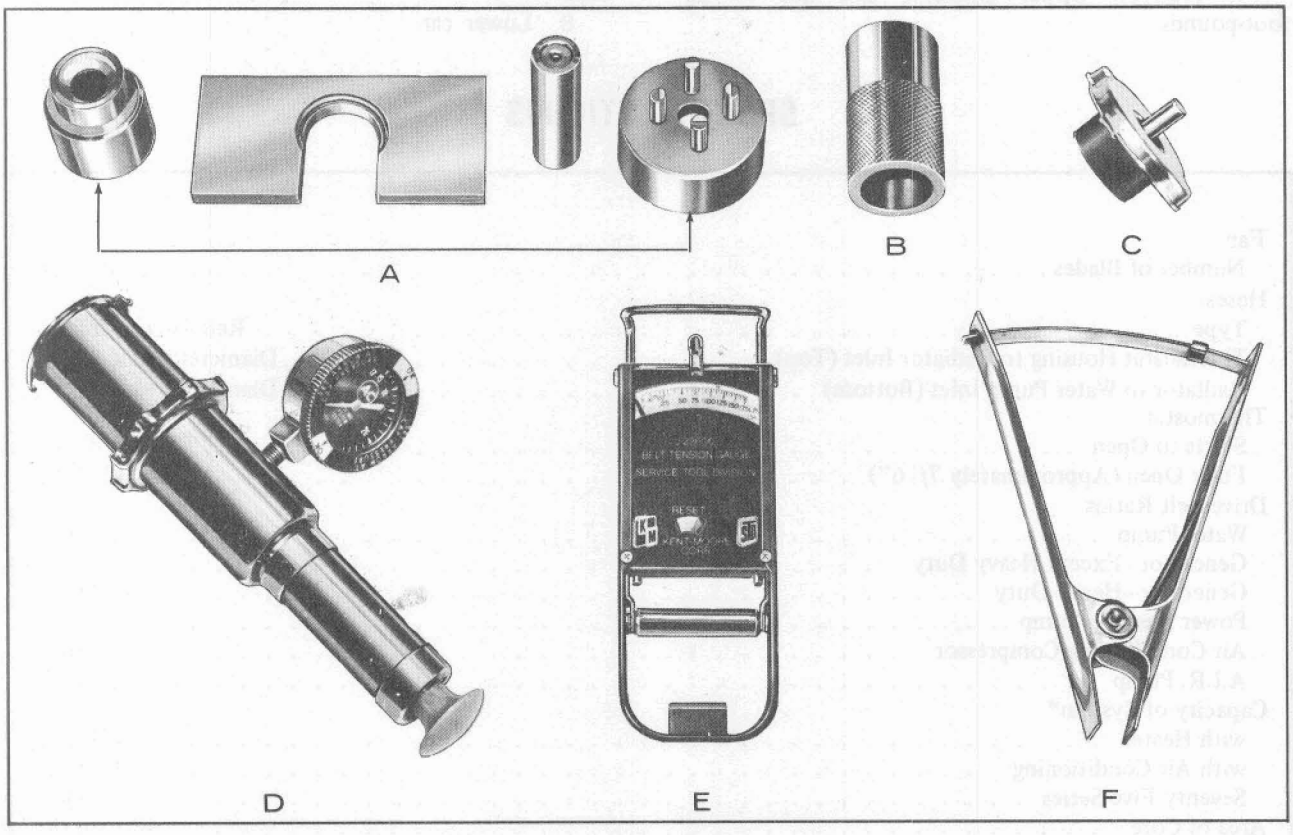


Fig. 6-14 Special Tools

KEY	TOOL NUMBER	NAME
A	J-23675*	Water Pump Overhaul Kit
B	J-8999-9	Seal Installer
C	J-23699	Pressure Tester Adapter
D	PCT-3	Pressure Tester
E	J-23600	Belt Tension Gage
F	J-23636	Hose Gage

*Water Pump Overhaul Kit, J-23675, consists of:

One J-23675-1 Shaft and Bearing Assembly Remover
One J-23675-2 Shaft and Bearing Assembly Installer
One J-23675-3 Shaft and Bearing Locator
One J-23675-4 Support Plate

DIAGNOSIS

BATTERY

11. Battery Visual Inspection

1. Inspect both positive and negative cables and connections for damage or corrosion. Ground cable connection at frame must be clean and tight.

2. Inspect metal carrier for corrosion. If corrosion exists, it will be necessary to remove retainer and battery from car and pour warm soda or ammonia water over corroded areas to loosen the corrosion so that it can be brushed off and flushed away.

3. The hold-down retainer should be inspected to see that it is tight enough to prevent the battery from shaking in its holder and damaging the battery case.

4. The battery posts and terminals should be inspected for corrosion. Corrosion appears as a white powdery substance. If they are corroded, wipe off the posts and terminals with a cloth dampened with household ammonia, or with a solution of water and baking soda. These alkaline solutions will neutralize any acid on parts being cleaned.

CAUTION: Care should be taken to keep cleaning solution out of battery cells; otherwise, the electrolyte will become permanently weakened.

5. Examine battery for cracks in case and excessive looseness in battery tray.

6. Check electrolyte level. Add only colorless, odorless drinking water as necessary to bring electrolyte level to bottom of the slot in each cell. Charge for 15 minutes at 15-25 amps. with vent caps removed. Connect a 300 amp. load for 15 seconds and proceed to Note 12.

7. If no visual defects are found, proceed to Note 12.

12. Specific Gravity Cell Comparison Test

If the electrolyte level is too low to be checked by a hydrometer, adjust electrolyte to the proper level by adding colorless, odorless drinking water. After water addition, the specific gravity check cannot be made until the battery is charged at a rate high enough to cause vigorous gassing for a period of 15 minutes or more. This insures that added water is mixed with the electrolyte before a specific gravity reading is taken.

1. Measure the specific gravity of each cell in the battery and the temperature of one of the center cells. Interpret readings as shown below.

2. When the specific gravity of the electrolyte falls within the 50 point variation between cells and the 1.230 to 1.310 specific gravity range, the battery is ready for use.

3. If any cell reads less than 1.100 and the battery has been in service more than three months, it should be replaced.

(NOTE: For service replacement of the 1972 Eldorado battery, use battery #R89W. Although smaller in size, this is a larger capacity battery.)

4. If any cell reads above 1.310, the battery may be returned to service. However, specific gravities above 1.310 are harmful to the battery and will cause an early failure. Such high readings are caused by the improper addition of electrolyte. Adjusting the specific gravity by pouring out the old solution and replacing it with electrolyte of the correct specific gravity will not correct the damage that has been done.

13. Testing Battery Condition

A battery testing instrument, designated a "421 Tester", is recommended to test the solid top batteries of all Cadillac vehicles. These "421" Testers, manufactured by several test equipment companies, will quickly determine the condition of a battery relative to state of charge and ability to provide satisfactory performance.

(NOTE: Do not charge batteries prior to making test. Be certain to obtain clean and tight connections before performing the "421" test.)

1. Perform "421" battery test following instructions on your particular test instrument.

2. Batteries designated Bad by "421" Tester should be replaced.

3. Batteries designated Good by "421" Tester may be returned to service if there is no owner complaint or other indication of poor performance.

4. Batteries designated Good by "421" Tester, but are questionable in service because of owner complaint or age of battery, should be further tested as outlined in Note 14.

Specific Gravity Difference Between Highest and Lowest Cells	Specific Gravity of Lowest Cell (Temp. Corrected)	Interpretation
Less than 50 points	More than 1.100	Proceed to "421" test (Note 13)
Less than 50 points	Less than 1.100	Proceed to load test (Note 14)
50 points or more	–	Defective battery – Replace

14. Battery Load Test

1. Charge battery, if necessary, until all cells are at least 1.200 specific gravity. If this is not possible in all cells, replace battery.
2. Remove vent caps and connect a 300 amp load for 15 seconds. Observe cells for signs of "smoke." If "smoke" is evident in one or more cells, replace battery.
3. Place a glass bulb thermometer, such as J-5421, in one cell.
4. Connect a voltmeter across the battery terminals.
5. Apply a 220 amp load and read the voltmeter after 15 seconds with the load connected.
6. Remove load and read thermometer.
7. Compare temperature and voltage readings with the following chart.

Temperature °F	Minimum Voltage
70° or greater	9.6
60° to 69°	9.5
50° to 59°	9.4
40° to 49°	9.3
30° to 39°	9.1
20° to 29°	8.9
10° to 19°	8.7
0° to 9°	8.5

8. If voltage is less than minimum specified in chart, replace battery.
9. If voltage is the same as or greater than minimum specified in chart, fully charge, clean terminals and return battery to service.

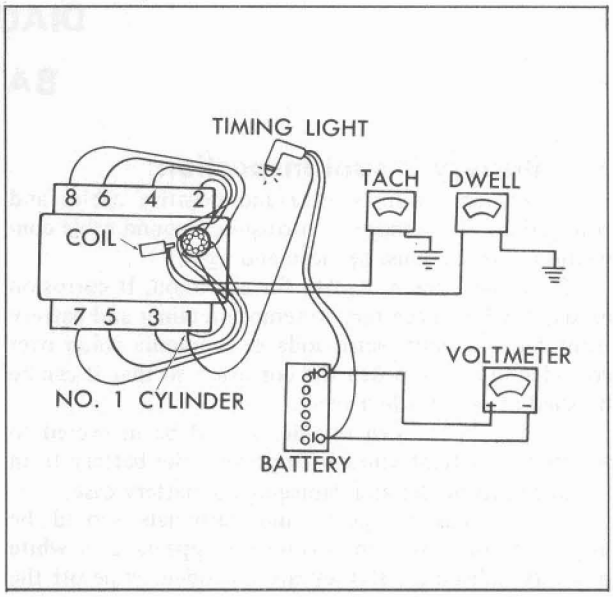


Fig. 6-15 Engine Tune-Up Instrumentation

15. Check Charging Voltage

1. With volt meter connected as in Fig. 6-15, operate engine to a speed of 1500 to 2000 RPM.
2. Observe voltmeter reading. Voltmeter should read between 13.1 and 15 volts.
3. If voltmeter reading is within correct range, shut off engine and disconnect instrumentation.
4. If voltmeter reading is not within specifications, further testing of charging system should be performed according to Note 55.

THEORY OF OPERATION

BATTERY

Battery

The familiar 12-volt negative-ground type electrical system is used on all Cadillac vehicles. A 12-volt secondary solid top battery, Fig. 6-16, is mounted in a tray on the right side of the radiator cradle assembly. The retainer grooves in the front and rear bottom sides of the battery, Fig. 6-16 and Fig. 6-17, secure the battery to the tray by means of a locking rod. Internal structure of battery, Fig. 6-16 and Fig. 6-17, secure the battery to has a capacity of 74 ampere hours.

The lead acid battery is a source of electrical energy that operates or assists in supplying current to the electrical accessories. Active materials within the battery react chemically to produce a flow of direct current whenever a current-consuming device, a load, is connected to the battery terminal posts. The 693 series battery has screw type side mounted battery cable terminals. The battery used in all other cars has clamped post terminals.



Fig. 6-16 Battery (Except 693)

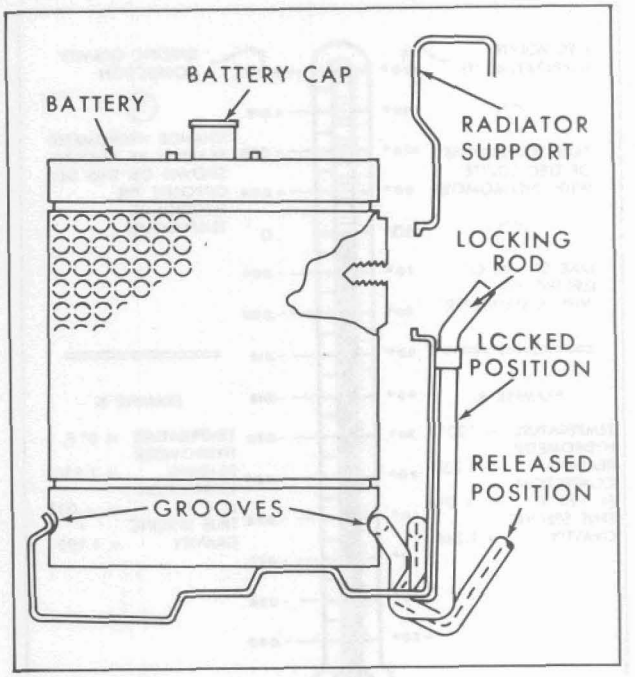


Fig. 6-17 Battery Retainer (693 Only)

SERVICE INFORMATION

BATTERY

The following battery service information applies to all Cadillac vehicles.

16. Battery Filling Instructions

The battery electrolyte level should be checked at every engine oil change. In warm weather, a check should be made at two-week intervals. An electrolyte level indicator vent cap is located in the second cell cap from the positive battery post. With the use of this vent cap, it is not necessary to remove cell vent caps when checking fluid level. A dark (black) spot in the center of this vent cap is visible when electrolyte is at the normal level. If at any time the electrolyte level drops below normal, the spot changes from black to an off-white color. When an off-white condition is encountered, all cell levels must be adjusted to their correct level. This is accomplished by raising the fluid level to the bottom of the slot in each cell with colorless, odorless drinking water.

CAUTION: Do not overfill battery or add any substance to fluid except colorless, odorless drinking water.

17. Use of Hydrometer

The hydrometer measures the percentage of sulphuric acid in the battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, the acid leaves the solution and enters the plates, causing a decrease in specific gravity of electrolyte. An indication of the concentration of the electrolyte is obtained with a hydrometer.

The specific gravity of the electrolyte varies not only with the percentage of acid in the liquid but also with

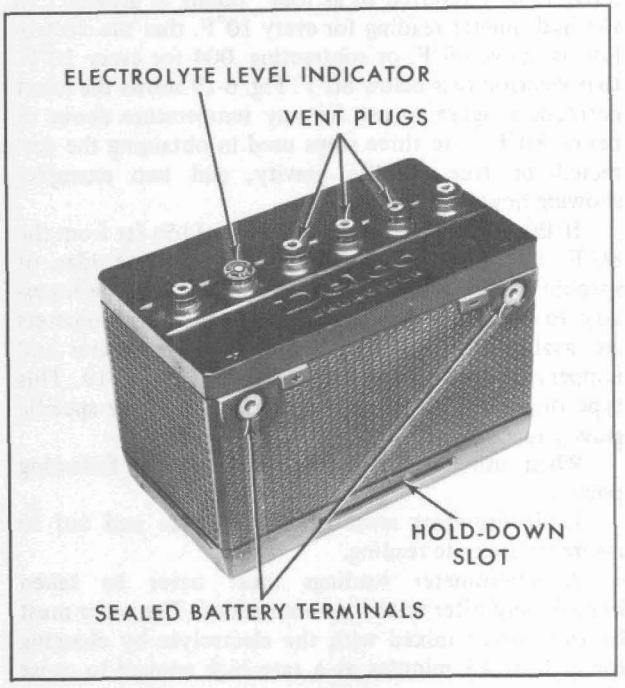


Fig. 6-18 Battery (693 Only)

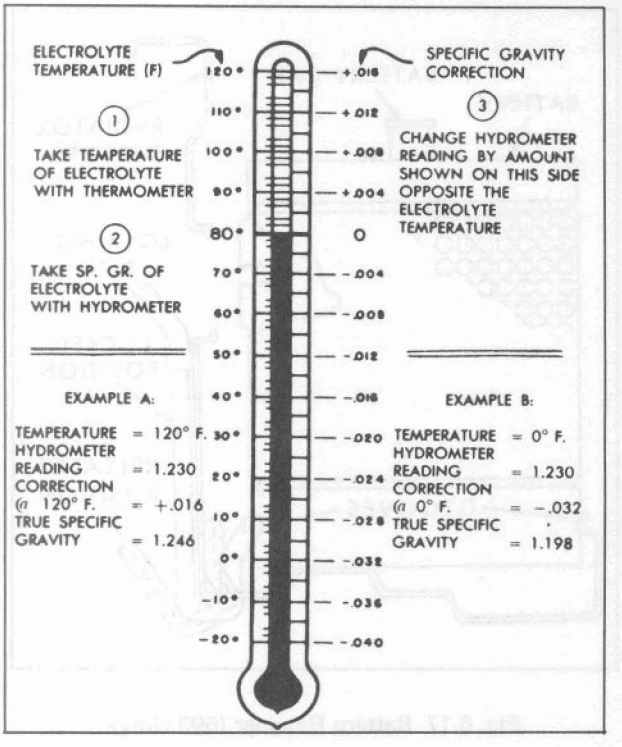


Fig. 6-19 Specific Gravity Temperature Correction Scale

temperature. As temperature increases, the electrolyte expands so that the specific gravity is reduced. As temperature drops, the electrolyte contracts so that the specific gravity increases. Unless these variations in specific gravity are taken into account, the specific gravity obtained by the hydrometer may not give a true indication of the concentration of acid in the electrolyte.

Correction can be made for temperature by adding .004, usually referred to as four "points of gravity", to the hydrometer reading for every 10°F. that the electrolyte is above 80°F. or subtracting .004 for every 10°F. that electrolyte is below 80°F. Fig. 6-19 shows the exact correction figure to use for any temperature above or below 80°F., the three steps used in obtaining the corrected or true specific gravity, and two examples showing how it is determined.

If the electrolyte temperature is not too far from the 80°F. standard, or if only an approximate idea of specific gravity reading is required, it will not be necessary to make the temperature correction. Hydrometers are available which have a built-in thermometer and temperature correction scale similar to Fig. 6-19. This type of hydrometer simplifies obtaining a true specific gravity reading.

When using a hydrometer, observe the following points:

1. Hydrometer must be clean, inside and out to insure an accurate reading.

2. Hydrometer readings must never be taken immediately after water has been added. The water must be thoroughly mixed with the electrolyte by charging for at least 15 minutes at a rate high enough to cause vigorous gassing.

3. If hydrometer has built-in thermometer draw liquid into it several times to insure correct temperature before taking reading.

4. Holding hydrometer vertically and draw in just enough liquid from battery cell so that float is free floating. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard the curvature where the liquid rises against float stem due to surface tension.

5. Avoid dropping battery fluid on car or clothing as it is extremely corrosive. Any fluid that drops should be washed off immediately with baking soda solution.

18. Causes of Low Battery Conditions (Except 693, Limousines and Commercial Chassis)

Common causes of low battery conditions other than those due to a defective battery are listed below, and should be investigated when there are indications that the car has a consistently low battery.

1. Excessive use of accessories with the engine not running.
2. Leaving lights on or doors open.
3. Improper installation of accessories.
4. Generator belt loose.
5. Incorrect regulator settings. These can be corrected and set, preferably toward high limit, as explained in Note 56.
6. Oxidized regulator contact points.
7. Self-discharge resulting from a dirty battery case.
8. Loose battery cables.
9. Low generator output, which may be checked and corrected as explained in Note 53.
10. A partial ground in positive side of battery circuit. With all switches in "OFF" position, a milliameter connected in series between battery positive post and battery cable should indicate zero or less than 5 milliamperes if car is equipped with Twilight Sentinel.

(NOTE: Be sure clock is wound before connecting ammeter.)

11. High resistance in charging circuits.

19. Battery Removal and Installation

a. Removal (Fig. 6-17)

1. Disconnect negative and positive battery cables at battery by using a heavy screwdriver to spread the spring clamp and lift clamps off posts. On 693 styles, remove cable covers and remove clamp bolts (captive on battery cable) securing cables to battery.

CAUTION: Do not spread cable clamps on C-car any more than necessary and do not pry clamps off battery post.

2. On 693 cars, disengage rod from clamp by moving toward side of car and move rod toward rear of car to disengage from battery groove, Fig. 6-17. On all other cars, push locking rod rearward to disengage from clamp on radiator support and move rod toward front of car to disengage from battery groove.

3. Remove battery from car being careful not to damage posts. On 693 styles, use battery remover tool J-23686. Place the adjustable arm jaw crossways against the terminal side of the battery first; then lock tool in

place by positioning lifting handle jaw to other side of battery and lift up on handle.

(NOTE: If tool J-23686 is not available, a belt can be used to remove the battery by tilting one end of the battery up and sliding the belt underneath. Belt must be secured at the top and used as a lifting handle.)

b. Installation (Fig. 6-17)

1. Clean all corrosion from battery posts, terminals, cable clamps and tray.
2. Place battery on battery tray. Position battery so that retainer tabs are positioned in grooves near bottom of battery, front of car on 693 and rear on all other series. On 693, terminals face rear of car.
3. On 693 cars, engage locking rod to battery groove and move rod toward front of car to radiator support. Secure in position behind clamp on baffle plate, Fig. 6-17. On all other cars, engage locking rod to battery groove and move rod toward rear of car engaging clamp on radiator support.
4. Connect positive battery cable first, then negative cable. On 693 styles, position cables to battery and secure with (captive in battery cable) clamp bolts. Tighten bolts to 70 in. lbs. and install cable covers. On all other styles, use a heavy screwdriver to spread the spring clamps and push them onto battery posts as far as possible. When installed, the clamps should be from flush to 1/8 inch below the top of post.

CAUTION: Do not drive clamps onto battery posts with hammer or other tool. The spring ring inside the clamp should never be reamed or cut as this will damage it.

5. Apply a light coat of oil or grease to the clamp terminals.

20. Care of Batteries Not in Use

Batteries in cars that are being stored require special care to prevent plate sulphation or other deterioration due to chemical action.

Before a wet charged battery is stored, an inspection should be made to see that it is filled to the proper level and that it is fully charged (1.250-1.280).

Wet batteries in storage should be checked every 30 days and given a boost charge of 25 per cent of the ampere hour rating of the battery at a rate of 5 amperes.

BATTERY CHARGING CHART

Condition	Rate	Time
Slow Charge	4 Amps	24 hours
Fast Charge	40-50 Amps	1 1/2 hours
Emergency Boost Charge	40-50 Amps	30 minutes
*Dry Battery Warm-up Charge	15 Amps	10 minutes
*Required for dry charged batteries being activated with electrolyte at a temperature below 60°F or batteries which are to go into immediate operation in below freezing temperatures.		

STARTING SYSTEM DIAGNOSIS

21. Cranking Voltage Test

1. Ground distributor end of coil secondary wire to keep engine from starting.
2. With ignition ON and voltmeter on 16 volt scale, crank engine.
3. Observe cranking voltage and engine speed. Voltage should be greater than 9 volts. Cranking speed should be at least 200 RPM (at room temperature).
4. If cranking voltage and engine speed are correct, shut off ignition and disconnect ground on coil secondary wire.
5. If voltage and engine speed are not correct, further testing of the battery, Notes 11 through 14 and starter circuit, Note 22 must be performed.

22. Starter Motor Circuit Resistance Test

a. Battery Cable and Starter Switch Test—Insulated Circuit Test

This test measures the resistance of the cables and switches that feed the starter motor. The heavy current used by the starter motor will produce a voltage drop in the wiring which can be measured as an indication of this resistance. The battery should be fully charged.

1. Disconnect primary lead of distributor from coil so engine will not start.

CAUTION: Do not remove high tension lead from coil center for this purpose, as this may damage the coil due to internal arcing.

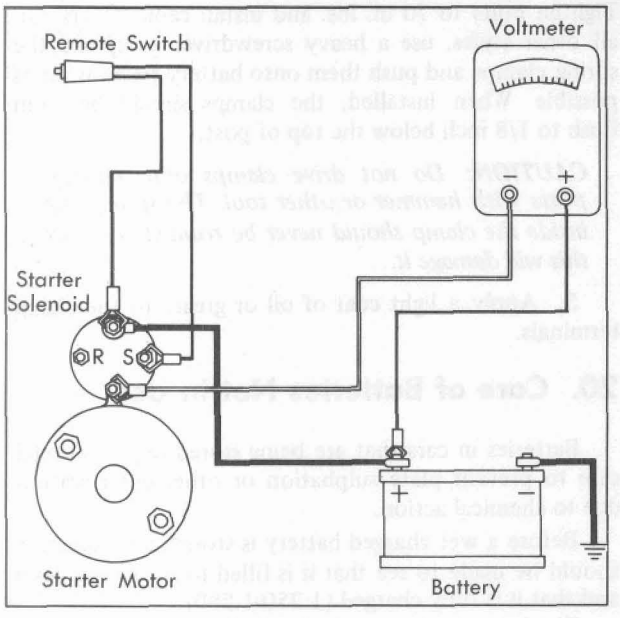


Fig. 6-20 Battery-Cable-To-Starter Test

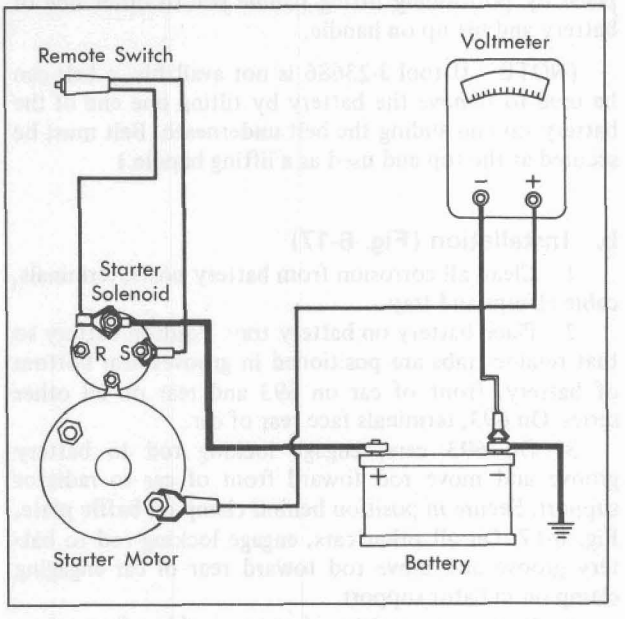


Fig. 6-21 Ground Circuit Test

2. Using Battery Starter Tester, turn voltmeter selector switch to 16-volt scale.

3. Connect starter solenoid remote switch and test leads as shown in Fig. 6-20.

4. Connect positive voltmeter lead to center of positive battery post, on which insulated battery cable is connected. Connect negative voltmeter lead to starting motor terminal, Fig. 6-20.

5. Close starter solenoid remote switch, and turn voltmeter to 4 volt scale while cranking. Observe reading, and immediately turn meter back to 16 volt scale.

6. Voltmeter should show .6 of a volt or less while engine is being cranked. If voltage drop is more than .6 of a volt, it is an indication that the cables or connections are dirty or corroded, the solenoid switch is defective, the battery is in a low state of charge, the starter motor is drawing too much current, or that the engine is tight.

7. If voltage drop across the entire insulated side of the battery starter circuit exceeds the specified .6 volt, test the individual parts of the insulated circuit for excessive resistance. Maximum voltage drop for each should not exceed the following specifications:

a. Battery to Solenoid Switch .4 volt
b. Across Solenoid Battery Terminal .2 volt
c. Solenoid Switch to Starter Terminal Zero

b. Ground Circuit Test

1. Turn voltmeter selector switch of Battery Starter Tester to 4 volt position.

2. Connect test leads as shown in Fig. 6-21.

3. Connect starter solenoid remote switch as shown in Fig. 6-21.

4. Connect negative voltmeter lead to a clean spot at center of negative battery post, not to the cable clamp.

5. Connect positive voltmeter lead to the starting motor through bolt.

6. With starter motor cranking engine, voltage drop should not exceed .3 volt. A reading of more than .3 volt is usually an indication of resistance due to loose, dirty, or corroded connections.

7. Connect primary lead of distributor to coil.

23. Checking Starter Motor Pinion Clearance

a. Preferred Method (Fig. 6-22)

1. Remove starter motor from car as described in Note 28.

2. Energize solenoid by applying 6 volts between solenoid "S" terminal and ground.

CAUTION: Do not use more than 6 volts or motor will operate. As a further precaution, connect a heavy jumper wire from the solenoid motor terminal to ground.

3. After energizing solenoid, press on clutch, Fig. 6-22, to take up movement.

4. Push pinion away from stop retainer as far as possible and use feeler gage to check clearance between

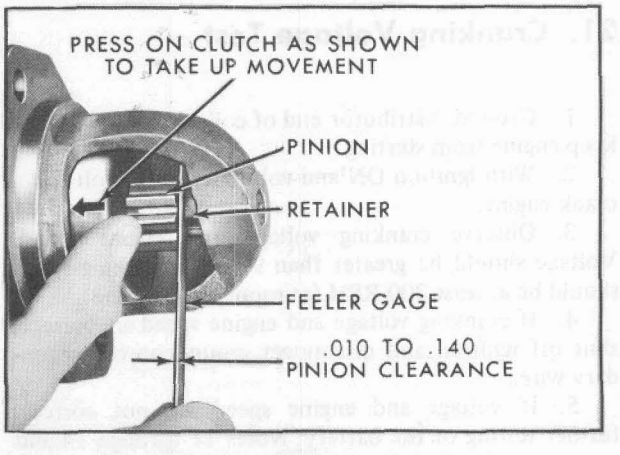


Fig. 6-22 Checking Pinion Clearance

starter motor pinion and pinion stop retainer, Fig. 6-21. Clearance should be .010 inch to .140 inch when pinion is in cranking position.

b. Alternate Method (Fig. 6-22)

If a six volt battery is not available, pinion clearance may be checked with a 12-volt battery in the following manner:

1. Remove starter motor from car as described in Note 28.
2. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.
3. Connect a 12 volt battery from the solenoid switch terminal to the solenoid frame.

Momentarily connect a jumper lead from the solenoid motor terminal to the solenoid frame. This will shift the pinion into cranking position and hold it there until the battery is disconnected.

5. After energizing solenoid, press on clutch, Fig. 6-22, to take up movement.
6. Push pinion away from stop retainer as far as possible and use feeler gage to check clearance between starter motor pinion and pinion stop retainer, Fig. 6- Clearance should be .010 inch to .140 inch when pinion is in cranking position.

(NOTE: Pinion clearance cannot be adjusted. If clearance is incorrect, disassemble starter motor and check for excessive wear of solenoid linkage, shift lever mechanism or improper assembly of these parts. All worn parts must be replaced.)

24. Checking Inoperative Starter Motor

If starter motor cranks engine slowly or not at all, check battery, battery terminals and connections, ground cable, and battery-to-starter motor cable. Corroded, frayed, or broken cables should be replaced, and loose or dirty connections corrected.

The overrunning clutch should withstand 80 to 85 foot-pounds torque without slipping. The pinion should turn freely and smoothly in the overrunning direction. The solenoid switch contacts should be checked for burned conditions, and the contact disc and terminal studs should be replaced if necessary.

Inspect brushes and commutator. Brushes should form a good contact with commutator and have the correct spring tension. If there are burned bars in the commutator, if may indicate open circuited armature coils that may prevent proper cranking. Inspect soldered connections at commutator rise bars, and resolder any damaged connections.

Tight or dirty bearings will reduce armature speed or prevent the armature from turning. A worn bearing, bent shaft, or loose pole shoe will allow armature to drag, causing slow speed or failure of the armature to rotate. Check for these conditions.

25. Starter Motor Inspection and Testing

Starter must be removed from car, Note 28, and disassembled, Note 29 to perform tests.

a. Visual Inspection

CAUTION: The overrunning clutch, armature, and fields should not be cleaned in a degreasing tank, or with grease dissolving solvents, since solvents would dissolve lubricant in clutch mechanism and damage the insulation in armature and field coils.

1. Test overrunning clutch action. Pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked or excessively worn. Replace clutch assembly if necessary.
2. Check bearings for signs of tightness, dirt or wear. Check for a bent armature shaft or a loose pole shoe screw.
3. Check brush holders to see that they are not deformed or bent so that brushes bind in their holders. Brush holders should be clean.
4. Check brushes for wear or damage in normal service. If worn down to one-half original length, brushes should be replaced.
5. See if full brush surface rides on the commutator when assembled, and if there is proper spring tension to give good firm contact. Replace weak brush springs.
6. Check brush leads and screws to be certain they are tight and clean. Clean leads, if necessary, and check tightness of screws.
7. Brush holding parts are replaced only if necessary, in the following manner:
   a. Remove brush holder pivot pin.
   b. Remove brush spring.
   c. Replace brushes by removing attaching screw, installing a new brush and securing with attaching screw. Trade name will be visible when brushes are correctly installed.
   d. Install brush spring by inserting it in slot in center frame.
   e. Install insulated brush and grounded brush, and secure with pivot pin.
8. Check fit of armature shaft in drive housing and in commutator end frame. Shaft should fit snugly in both bushings. If bushing in drive housing is worn, it will be necessary to replace the drive housing. If bushing in commutator end frame is worn, replace commutator end frame.
9. Inspect leather brake washer for damage, and replace, if necessary.

b. Checking Armature for Shorts

1. Place armature in growler. Lock armature in position by securing clamp on the commutator. Turn ON-OFF switch on.
2. Rotate armature while holding steel strip that comes with the tester near the armature. Steel strip will vibrate in the area of a short circuit. Turn off switch.

c. Checking Armature for Opens

1. Inspect the points where conductors are joined to the commutator for loose connections. Poor connections can cause arcing and burning of the commutator.
2. If bars are not badly burned, resolder leads in riser bars. Have commutator turned down in a lathe.

d. Checking Armature for Grounds

Check for grounds with aid of a 110-volt test lamp.

1. Remove armature from armature tester and place on bench.
2. Place one test lamp lead on the commutator.
3. Touch other test lamp lead to armature core and then armature shaft. If lamp lights, the armature is grounded.

If the commutator is worn, dirty or out of round, a ground condition may result. If a ground is indicated, have commutator turned down in a lathe.

e. Checking Field Coils for Grounds

Check field coils for grounds and opens, using 110-volt test lamp.

a. Connect one lead of test lamp to motor feed terminal and other to any clean surface of field frame. Lamp should not light.

If lamp lights, field coils are grounded and must be replaced.

f. Checking Field Coils and Insulated Brush Holder Leads

1. With center frame assembly positioned so that brush holders are on top, push upper motor feed terminal from center frame assembly.
2. Touch one test lamp lead to each of motor feed terminals. Lamp should light. If it does not light, there is an open in field coils and field coil assembly must be replaced.
3. If the lamp lights, perform Step 4 to check insulated brush holder leads.
4. Hold one test lamp lead to either motor feed terminal. Touch other lead in turn to two pigtail leads of insulated brushes. Lamp should light.

If lamp does not light in either instance, leads should be repaired by soldering. Be sure to install upper motor feed in grommet.

THEORY OF OPERATION

STARTER

Starter

The starter motor is mounted on the right rear side of the engine. The starter motor has four pole shoes and a two series field. The drive end housing encloses the entire shift lever mechanism. An overrunning clutch drive is used to engage the cranking motor pinion with the transmission flywheel.

When the control switch is closed, the solenoid is energized, shifting the cranking motor pinion into mesh with the flywheel. The main contacts of the solenoid are then closed so that battery current is delivered to the starter motor.

SERVICE INFORMATION

STARTER

26. Starter Motor Circuit

The starter motor is engaged when the ignition key is turned to the extreme right position. Engagement is obtained by means of a solenoid, Fig. 6-23 attached to the starter housing. The solenoid first engages the starter pinion with the flywheel gear and then closes the main switch so that the battery current is delivered to the starter motor.

The starter solenoid is drawn into the engaged position by both the pull-in coil and the hold-in coil, and held in position by the hold-in coil only, Fig. 6-23. The contact bar at the end of the solenoid completes a direct circuit between the battery and the starter motor, energizing the starter motor and shorting out the pull-in coil.

The current consumption of the solenoid switch should be 41-47 amperes at 10 volts for both windings, and 14.5 - 16.5 amperes at 10 volts for the hold-in winding alone.

27. Starter Motor Maintenance

When the starter motor is disassembled for service, apply a light coating of lubricant on the bushings in the end bearings. Avoid excessive lubrication, as this might force lubricant out onto the commutator where it would gum and cause high resistance, resulting in poor starter motor performance. Never lubricate the commutator.

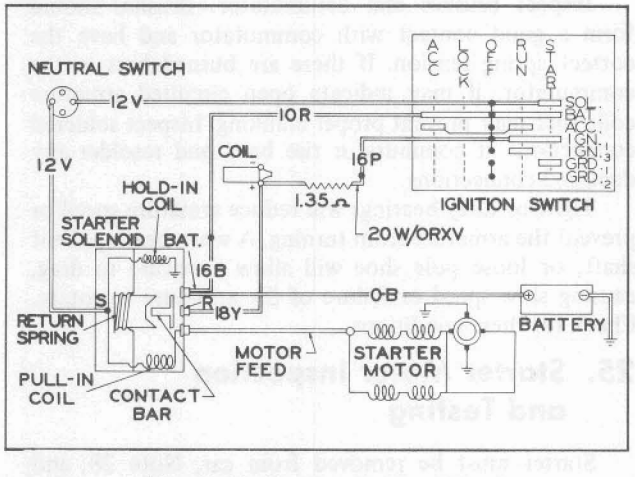


Fig. 6-23 Starting System Circuit

28. Starter Motor—Removal and Installation

a. Removal

1. Disconnect negative battery cable at battery.
2. On 693 series cars, disconnect starter harness multiple connector at right rear of engine.
3. Raise front end of car.
4. Disconnect battery lead at starter solenoid terminal (except 693).
5. Disconnect neutral switch wire and coil feed wire at starter solenoid terminals (except 693).
6. Remove spring clip securing wire to solenoid housing (693 only).
7. Remove screw and nut securing support bracket to starter and crankcase.
8. Remove two screws that hold starter motor to crankcase.
9. Remove starter motor by pulling it forward; then toward RH front wheel and up over steering linkage toward rear of car.

b. Installation

1. Position starter motor in proper location in flywheel housing.
2. Install two screws holding starter motor to crankcase. Tighten screws to 46 foot-pounds.
3. Install starter motor support bracket and secure with screw and nut. Tighten screw to 12 ft. lbs. and nut to 6 ft. lbs.
4. On all except 693 series cars, install starter motor harness to terminals on solenoid.
5. Install spring clip securing solenoid wires to solenoid housing (693 only).
6. Lower car.
7. On 693 series cars, connect starter harness to underhood harness at right rear of engine.
8. Connect negative battery cable to battery.

29. Starter Motor—Disassembly and Assembly

CAUTION: When the starter motor is disassembled for cleaning and inspection of parts, the overrunning clutch, armature, and fields should not be cleaned in a degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and would damage the insulation in the armature and field coils. Worn parts should be replaced, and the commutator should be turned down in a lathe if necessary.

a. Disassembly (Fig. 6-24)

1. Disconnect field coil connector from solenoid motor terminal.
2. Remove two screws and lockwashers that hold solenoid switch assembly to starter drive housing and remove solenoid and solenoid return spring by rotating

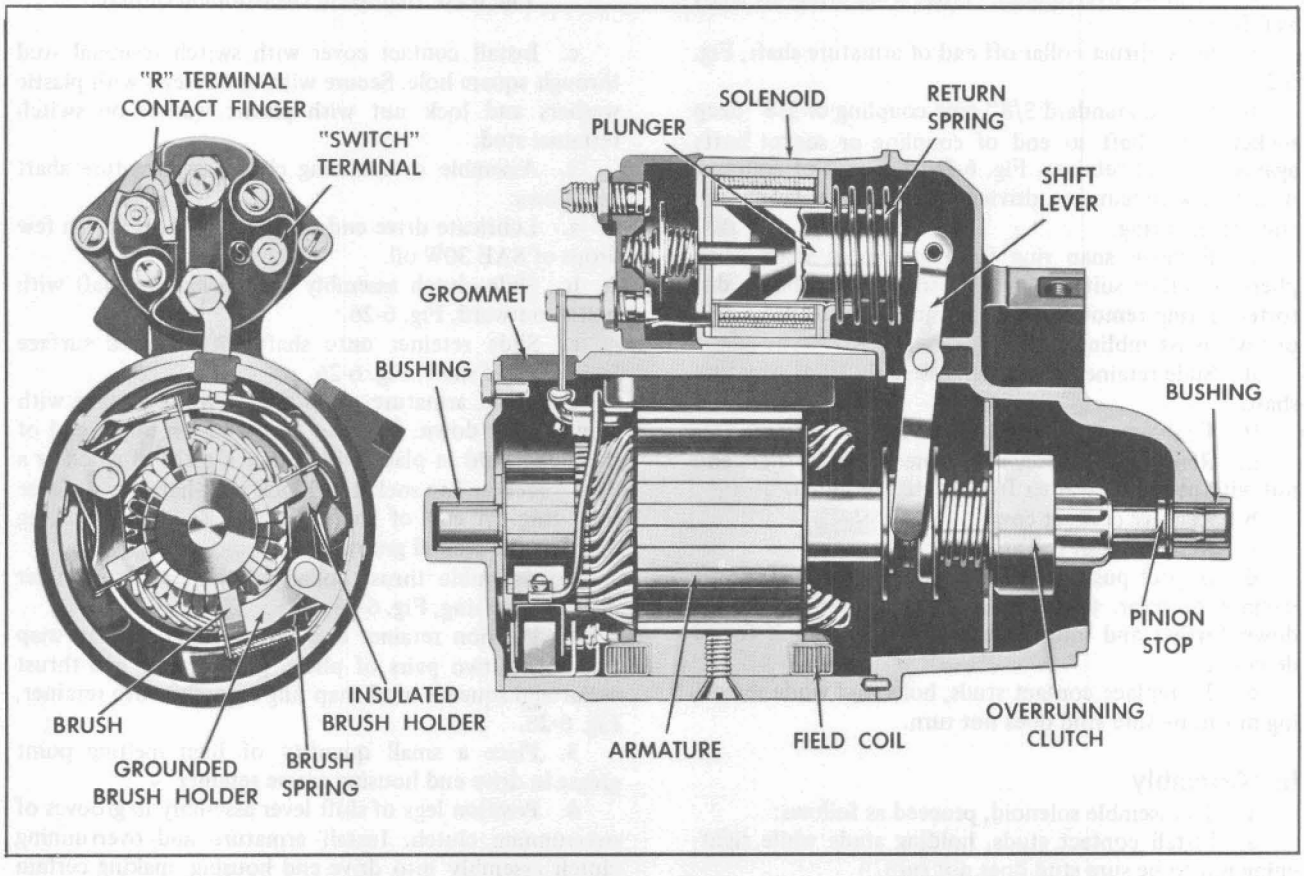


Fig. 6-24 Starter Motor Cutaway View

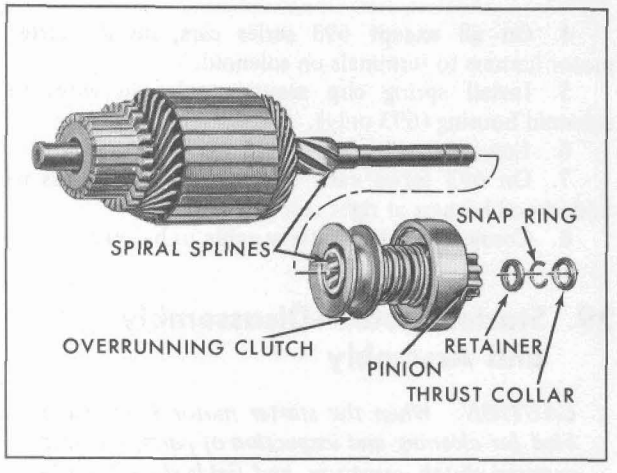


Fig. 6-25 Starter Armature Assembly

solenoid assembly counterclockwise to release solenoid flange from center frame.

3. Remove two through bolts.

4. Remove commutator end frame and leather brake washer.

5. Remove center frame assembly.

6. Remove snap ring that holds shift lever pivot pin, using snap ring pliers, J-4880, and remove pivot pin from drive housing.

7. Remove plunger and shift lever assembly and armature assembly with overrunning clutch from drive end housing.

8. Remove overrunning clutch from armature shaft as follows:

a. Slide thrust collar off end of armature shaft, Fig. 6-25.

b. Slide a standard 3/8" pipe coupling or 5/8" deep socket onto shaft so end of coupling or socket butts against edge of retainer, Fig. 6-26. Tap end of coupling or socket with hammer, driving retainer toward armature and off snap ring.

c. Remove snap ring from groove in shaft using pliers or other suitable tool. If snap ring is badly distorted during removal, it will be necessary to use a new one when assembling shaft.

d. Slide retainer and clutch assembly from armature shaft.

9. To disassemble solenoid, proceed as follows:

a. Remove two screws with neoprene washers and nut with neoprene washer from switch terminal.

b. Remove contact cover.

c. Remove push rod assembly.

d. Inspect push rod assembly and contact studs for damage or wear. Contact assembly cannot be broken down further and must be replaced as a unit if found defective.

e. To replace contact studs, hold stud while removing nut to be sure stud does not turn.

b. Assembly

1. To assemble solenoid, proceed as follows:

a. Install contact studs, holding studs while tightening nut to be sure stud does not turn.

b. Install push rod assembly.

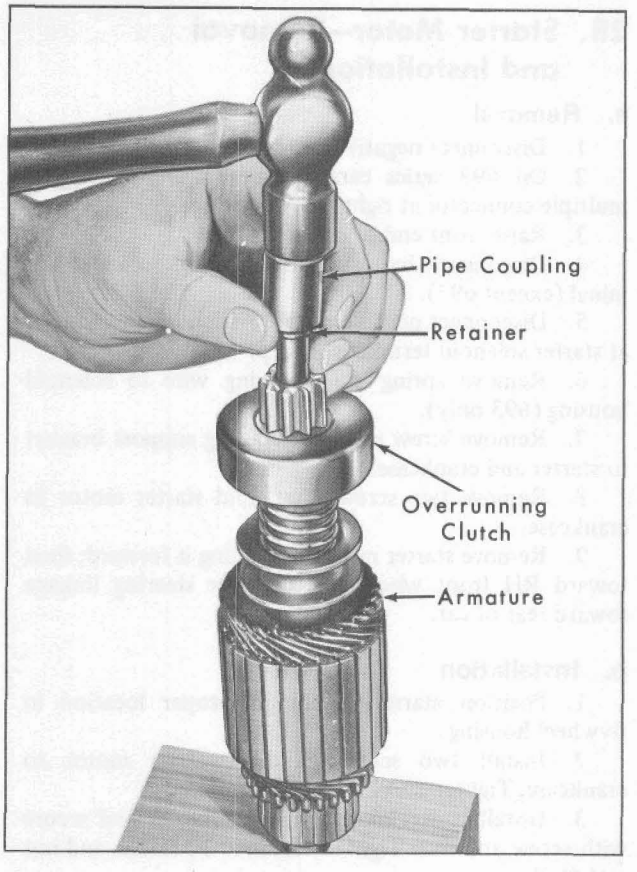


Fig. 6-26 Removing Overrunning Clutch

c. Install contact cover with switch terminal stud through square hole. Secure with two screws with plastic washers and lock nut with plastic washer on switch terminal stud.

2. Assemble overrunning clutch to armature shaft as follows:

a. Lubricate drive end of armature shaft with a few drops of SAE 30W oil.

b. Slide clutch assembly onto armature shaft with pinion outward, Fig. 6-26.

c. Slide retainer onto shaft with cupped surface facing end of shaft, Fig. 6-26.

d. Stand armature on end of a wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with either a piece of wood or a 7/16" socket. Tap socket or block with hammer to force snap ring on end of shaft, Fig. 6-27. Slide snap ring down to the second groove.

e. Assemble thrust collar on shaft with shoulder next to snap ring, Fig. 6-28.

f. Position retainer and thrust collar next to snap ring. Using two pairs of pliers, grip retainer and thrust collar and squeeze until snap ring is forced onto retainer, Fig. 6-28.

3. Place a small quantity of high melting point grease in drive end housing grease retainer.

4. Position legs of shift lever assembly in grooves of overrunning clutch. Install armature and overrunning clutch assembly into drive end housing, making certain that thrust washer is in place on end of shaft.

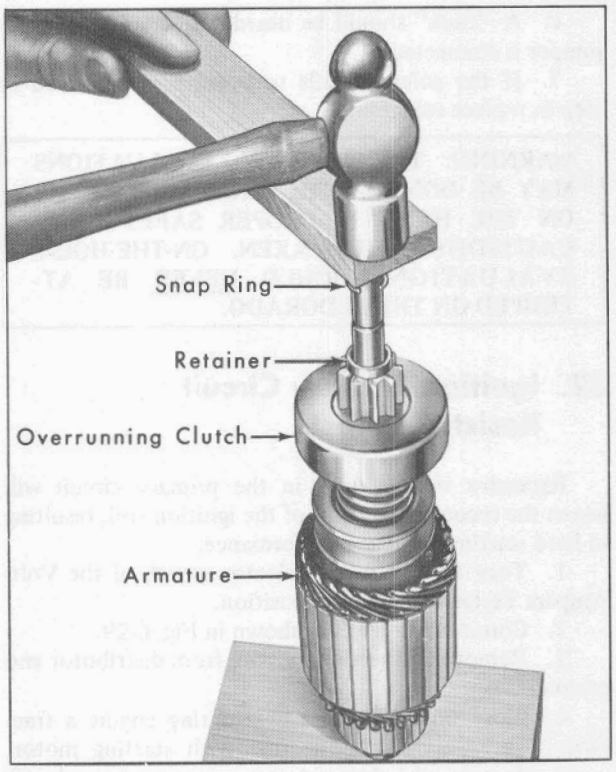


Fig. 6-27 Installing Snap Ring on Shaft

5. Install shift lever pivot pin into recess in housing and secure with snap ring, using Snap Ring Pliers, J-4880.

6. Mount starter in a vise and install solenoid return spring and solenoid switch assembly. Secure with two attaching screws and lock washers.

7. Apply a non-hardening sealing compound to area where center frame will contact solenoid case flange.

8. Install center frame assembly on drive end housing by starting assembly over armature, spreading brush holders apart to engage commutator and mating dowel pin on frame with dowel pin hole in drive end housing.

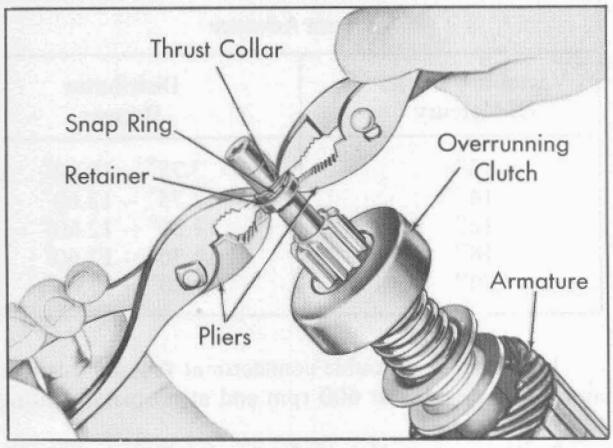


Fig. 6-28 Installing Snap Ring on Retainer

9. Place a small quantity of high melting point grease on bushing in commutator end frame.

10. Place leather brake washer on armature shaft.

11. Slide commutator end frame on shaft and secure with two through bolts.

12. Install field coil terminal connector on solenoid motor terminal, securing with self-tapping screw and star washer.

30. Fusible Links

Fusible links are used to protect the engine primary harness at the starter motor. Fusible link wire is usually 4-6 wire gage sizes smaller than the circuit it protects. Should the fusible link wire break as the result of a short circuit, first find the source of the short circuit and repair. Because of the smaller diameter wire, a small change in the length of the fusible link would result in a large change in the "fuse rating" of the wire. For this reason it is important to replace damaged fusible links with a new piece of fusible link wire, cut to the correct length, which is available from various sources.

IGNITION SYSTEM DIAGNOSIS

31. Distributor Test Information

For service departments equipped with distributor testing machines, the information on 1972 distributors is furnished as follows:

(NOTE: Vacuum advance starts at 8.00 inches to 10.00 inches of mercury. Maximum distributor vacuum advance is 11.30° to 12.60° at 13.00 inches of mercury or greater.)

If tests indicate an improperly operating mechanism, disassemble the distributor as described in Note 50a. Reassemble the distributor as described in Note 50b.

a. Thermal Vacuum Switch

To check the operation of the switch, proceed as follows:

Centrifugal Advance	
Distributor Speed rpm	Distributor Spark Advance
300	0° – 0°
400	0° – 1°
600	1° – 3°
800	3° – 5°
1000	4-3/4° – 6-3/4°
1200	6° – 8°
1400	7-1/4° – 9-1/4°
1600	8-1/2° – 10-1/2°
1800	9-3/4° – 11-3/4°
2000	11° – 13°

Vacuum Advance	
Vacuum – Inches Of Mercury	Distributor Degrees
12"	3.75° – 10.00°
14"	7.75° – 12.60°
16"	11.30° – 12.60°
18"	11.30° – 12.60°
20"	11.30° – 12.60°

1. Disconnect double connector at vacuum solenoid and operate engine at 600 rpm and at normal operating temperature.
2. Disconnect hose from distributor vacuum advance unit and check to see that vacuum is available (to port "D").
3. With distributor hose disconnected, remove hose between switch and vacuum break "tee" at carburetor.
4. Vacuum should still be available at distributor hose (port "D" and should not be available at hose disconnected in step #3 (port "MT").
5. To raise engine temperature to check transition of vacuum sources, block radiator with cardboard until "STOP ENGINE" light comes on.
6. Reconnect hose removed in step #3 (switch to vacuum break "tee") and remove hose between carburetor and port "C" of the switch.
7. Vacuum should be available at distributor hose (port "D") and should not be available at hose disconnected in step 6.
8. Make normal connections and proceed to part b of this note.
9. Should any of the above checks indicate an improperly operating switch, the switch should be replaced.

b. Speed Controlled Spark System

Testing the speed controlled spark system should be accomplished under actual driving conditions as follows:

1. Disconnect the double connector at the vacuum solenoid and insert a test light between the connector leads. Test light leads must be long enough to allow the lamp to be located outside the engine compartment.
2. Tape the test lamp to the fender, cowl or some other visible area and close hood.
3. Drive the car and observe the test light for the following conditions:
   a. Lamp should go out at 33 ± 2 miles per hour.
   b. Lamp should come on again as vehicle speed descends past 25 miles per hour.
4. If test lamp does not operate as described in step 3, connect a jumper wire between the 18B and ground and repeat step 3.
5. If test lamp still does not operate as described in step 3, replace speed sensor as described in Notes 106, 107 or 108.
6. To test operation of the vacuum solenoid, proceed as follows:
   a. Connect a jumper wire between one of the solenoid terminals and ground.
   b. Momentarily touch a jumper wire from the battery positive terminal to the other solenoid terminal.
   c. A "click" should be heard or felt each time the jumper is connected.
7. If the solenoid fails to operate as described in step 6, replace solenoid.

WARNING: THE PRECEDING EVALUATIONS MAY BE DONE IN THE SHOP WITH C-CARS ON THE HOIST IF PROPER SAFETY PRECAUTIONS ARE TAKEN. ON-THE-HOIST EVALUATION SHOULD NEVER BE ATTEMPED ON THE ELDORADO.

32. Ignition Primary Circuit Resistance Test

Excessive voltage drop in the primary circuit will lessen the secondary output of the ignition coil, resulting in hard starting and poor performance.

1. Turn the voltmeter selector switch of the Volt-Ampere Tester to the 4 volt position.
2. Connect test leads as shown in Fig. 6-29.
3. Remove coil secondary wire from distributor and ground.
4. Close breaker points by rotating engine a fraction of a revolution at a time with starting motor.
5. Be sure all lights and accessories are turned off.
6. Turn ignition switch "On". Voltmeter should read not more than .4 volt.
7. Test ignition switch by turning it off and on several times. Voltmeter should record the same reading each time switch is turned on.

(NOTE: While switch is being turned on and off, key should be jiggled in switch several times and voltmeter checked for any change in readings.)

8. Test all wires for tightness. Move them about and note any change in meter reading.
9. Remove voltmeter leads and place them across the primary wires from coil to distributor as shown by

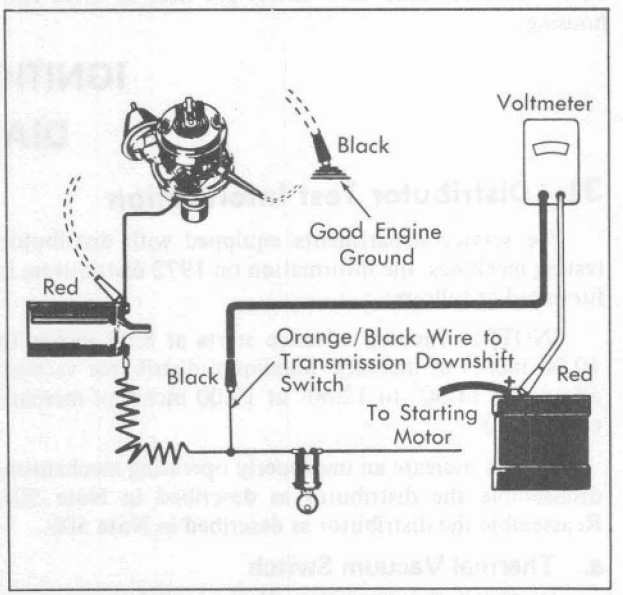


Fig. 6-29 Ignition Primary Circuit

dotted leads in Fig. 6-29. Voltmeter should read less than .1 volt.

(NOTE: If voltmeter reading exceeds the specified maximum, isolate the point of this resistance by placing the test leads across each connection and wire in order. The reading across a connection should be proportional to its length as compared to the length and allowable voltage drop of the engine circuit.)

THEORY OF OPERATION

Ignition System

Distributor

An ignition distributor, of aluminum alloy, is mounted on the top left front of the engine. It is fully automatic in operation, and driven by an alloy iron gear that meshes with a gear that is integral with the camshaft. The distributor cam rotates in a clockwise direction when viewed from above. The firing order is 1-5-6-3-4-2-7-8.

The distributor houses the contact points that make and break the primary circuit, and also directs high voltage and current in proper sequence to the spark plugs. The distributor contact point set is replaced as a complete assembly. The breaker lever spring tension and point alignment on the replacement set are factory adjusted, leaving only the dwell angle to be adjusted after installation.

The large molded distributor rotor, located above the breaker plate assembly serves as a cover for the centrifugal advance mechanism, and distributes high voltage and current to fire the spark plugs.

The one-piece distributor cap is made from an alkyd substance to resist carbon tracking.

When the rotor is removed, the centrifugal advance mechanism should be inspected for lubricant. If necessary, a small amount of cam and bearing lubricant should be applied to the advance weights. When contact point sets are changed, refer to Note 36 for cam lubricator recommendations.

Vacuum Advance

A thermostatically controlled vacuum distribution switch is mounted in the upper left front of the cylinder block.

When the coolant temperature is below 220°F, carburetor vacuum is supplied to the vacuum advance mechanism through the thermo switch. Once the coolant temperature rises above 230°F, the switch closes the carburetor supply port and opens the manifold supply port.

This system is designed to provide spark control during prolonged idling periods or in unusually warm weather. Under these conditions, when air flow through the carburetor is nominal and carburetor vacuum is low, stronger manifold vacuum is used to operate the vacuum advance unit to provide the proper spark advance.

During normal engine operation carburetor vacuum operates the vacuum advance unit because it more closely follows actual engine requirements. A second spark control device is used to prevent vacuum advance at low speeds. This speed controlled spark advance solenoid is mounted on a bracket in front of the ignition coil and serves to close the distributor vacuum advance hose in response to an electrical signal based on car speed.

This system is necessary to help control vehicle exhaust emissions.

Ignition Timing

On the left side of the engine front cover directly below the distributor is a tab with saw toothed notches to indicate degrees of crankshaft advance. The pistons in number one and number four cylinders are at top dead center when the "O" notch is in line with notch on the rear flange of the pulley. The marks indicate the number of crankshaft degrees the spark plug will fire before or after the top dead center position of the piston.

Secondary Circuit

Type R-46-N spark plugs are installed as original equipment on all 1972 Cadillac engines. A ribbed insulator is used to reduce the possibility of voltage breakdown.

Radio suppression spark plugs are used in addition to resistance core spark plug cables to reduce ignition noise radiated into the atmosphere.

The oil-impregnated ignition coil is mounted on top of the intake manifold in front of the carburetor. The interrupted low tension voltage from the battery produces a high voltage in the secondary circuit of the coil. A resistance type wire is connected from the ignition switch to the ignition coil in the primary circuit. This resistor reduces the voltage at the coil from 12 volts down to range of 8-1/2 to 10-1/2 volts under normal operating conditions. To insure adequate ignition voltage during the engine cranking period, the resistor wire is by-passed by a feed from the starter solenoid, and full cranking voltage is supplied to the ignition coil during this period.

SERVICE INFORMATION

IGNITION SYSTEM

33. Distributor Removal and Installation

a. Removal

1. Removal distributor cap as shown in Fig. 6-30 and position out of way.
2. Disconnect distributor primary wire from coil.
3. Disconnect vacuum advance hose from vacuum advance unit on distributor.
4. Crank engine until contact on top of rotor points directly to No. 1 spark plug firing position. Mark the position on distributor housing.
5. Remove distributor hold down nut and clamp.
6. Lift distributor from engine.

b. Installation

1. Install distributor with contact on top of rotor pointing slightly counterclockwise from No. 1 spark plug firing mark. As distributor gear meshes with cam gear, rotor will turn slightly clockwise. When distributor is properly installed, rotor should point directly at No. 1 spark plug firing position mark.

(NOTE: If engine has been cranked, remove No. 1 spark plug. Place thumb over port. Crank engine until compression is noticed and continue until No. 1 piston is at top dead center. In this position, the timing mark "O" on the engine front cover lines up with the scribe mark on the harmonic balancer.)

2. Install distributor hold-down clamp and nut.
3. Connect distributor primary lead.
4. Install distributor cap.
5. Set timing as described in Note 38.
6. Connect vacuum advance hose to vacuum advance unit.

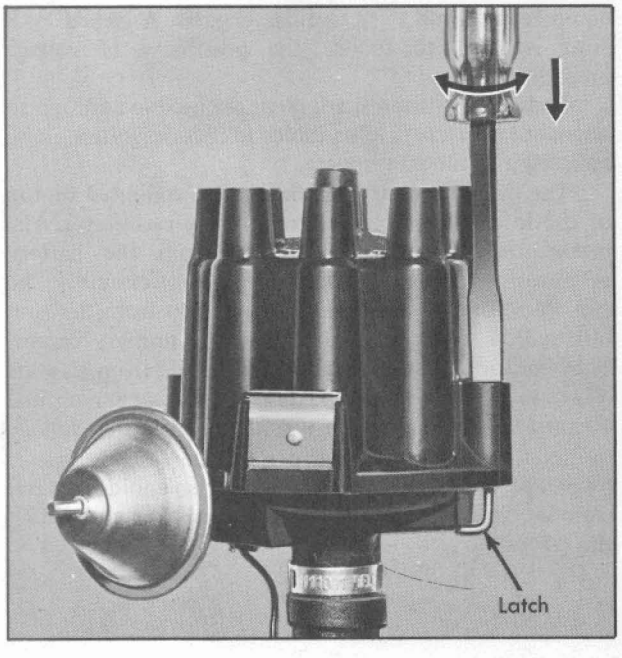


Fig. 6-30 Removing Distributor Cap

34. Distributor Disassembly and assembly

a. Disassembly (Fig. 6-31)

1. Remove rotor from end of distributor shaft by removing two attaching screws and lockwashers.
2. Remove two weight springs and both advance weights.
3. Remove pin from gear by driving out with drift punch and hammer.

CAUTION: Distributor gear should be supported in such a way that no damage will occur to distributor shaft when driving pin out.

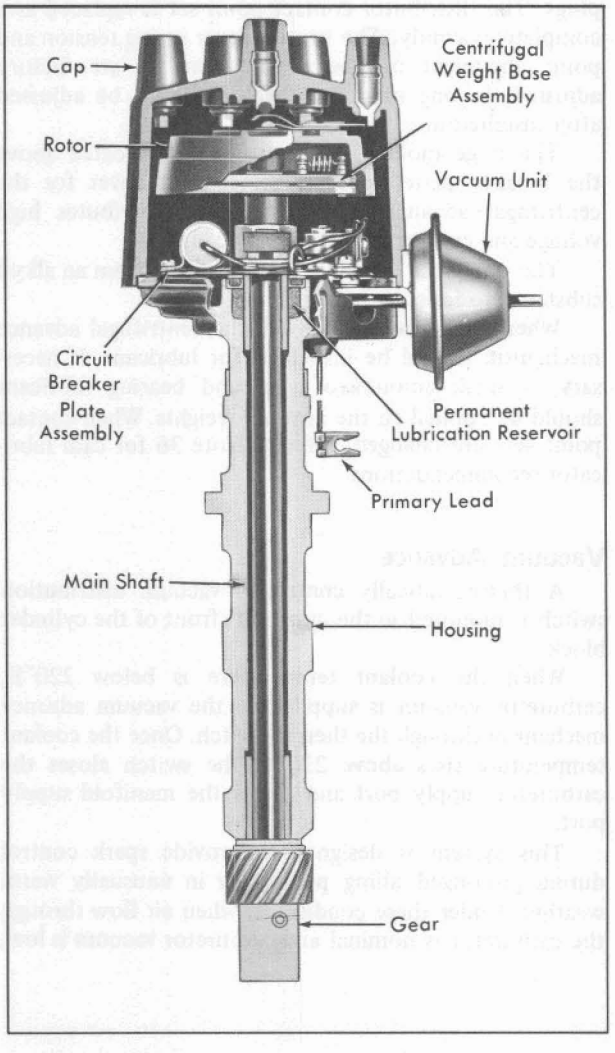


Fig. 6-31 Distributor Cutaway View

4. Slide gear off shaft, remove any burrs that may have been caused by removal of pin.
5. Pull shaft with cam weight base assembly from housing.
6. Remove contact point assembly and disconnect primary and capacitor lead clips.
7. Remove capacitor hold-down screw and remove capacitor and bracket from breaker plate.
8. Remove spring retainer and raise breaker plate from housing.
9. To remove vacuum advance unit, remove two attaching screws, lockwashers, and plate with ground lead.
10. Remove primary lead by prying rubber grommet out of base housing.
11. Remove felt washer from bushing in housing.

(NOTE: No attempt should be made to service shaft bushing in housing.)

b. Assembly

1. Place felt washer over bushing in housing.
2. Slide primary lead through opening in base of housing and seat grommet in housing.
3. Place vacuum advance unit in space provided in housing and retain in position by installing one screw in hole in mounting arm furthest from advance unit.
4. Secure distributor ground lead to vacuum advance unit with second mounting screw. Primary wire should cross over ground lead.
5. Install breaker plate assembly over bushing so that assembly is positioned over vacuum advance operating arm.
6. Install spring retainer.
7. Place capacitor and bracket in position on breaker plate and secure with one screw.
8. Install contact point assembly.
9. Install capacitor and primary leads as shown in Fig. 6-32.
10. Install shaft with cam weight base assembly into housing.
11. Install gear on shaft and secure with pin. Use new pin.
12. Install both advance weights on cam weight base and secure with two springs.
13. Install rotor and secure with two screws and lockwashers.

CAUTION: The square and round lugs on bottom of rotor must be positioned with corresponding holes on cam weight base.

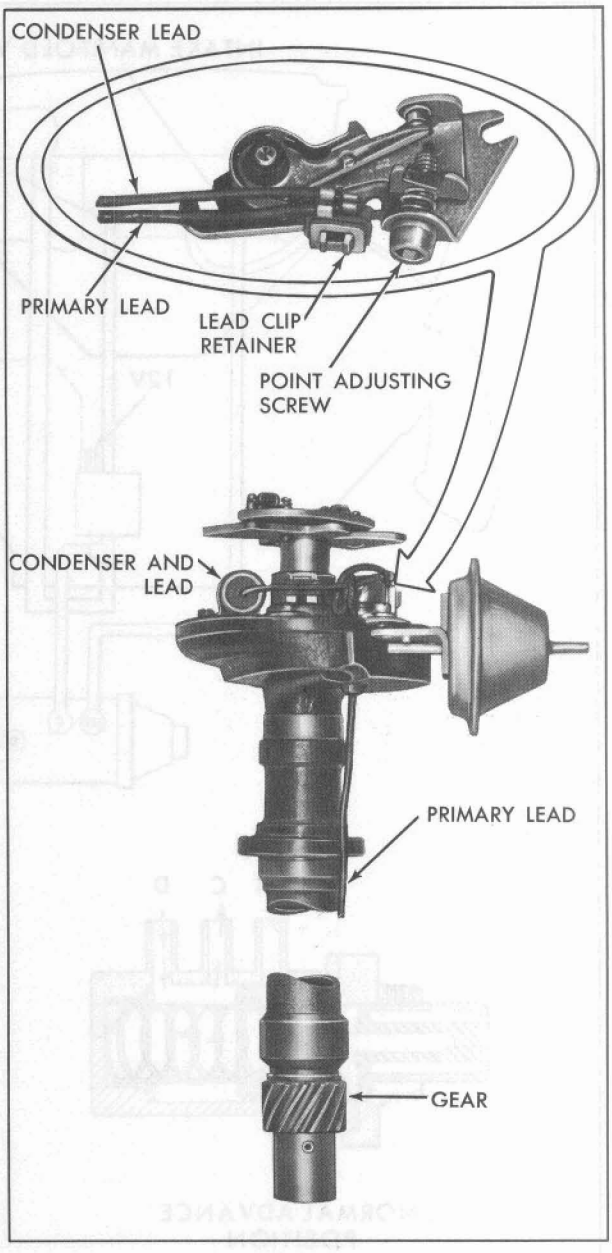


Fig. 6-32 Distributor Point Lead Retainer and Drive Gear

35. Distributor Vacuum Advance Controls (Fig. 6-33)

Two separate devices are used to control operation of the vacuum advance unit at various times. The first device is the Thermal Vacuum Switch which delivers manifold vacuum to the advance unit during periods of high coolant temperature. Operation of this system is explained in Part a of this note. The second device is the Speed Controlled Spark System which shuts off vacuum to the advance unit until car speed has reached approximately 33 m.p.h. Operation of this system is explained in Part b of this note.

a. Thermal Vacuum Switch (T.V.S.)

The thermal vacuum switch, Fig. 6-33, is designed primarily to help prevent overheating by providing full vacuum spark advance during prolonged idling periods or during unusually warm weather. Under these conditions spark advance is desirable, and since the speed controlled spark system prevents spark advance at low speeds, stronger manifold vacuum is used to override the spark control system and operate the vacuum advance unit. During normal operation, carburetor vacuum (spark port vacuum) operates the vacuum advance unit because it more closely follows actual engine requirements.

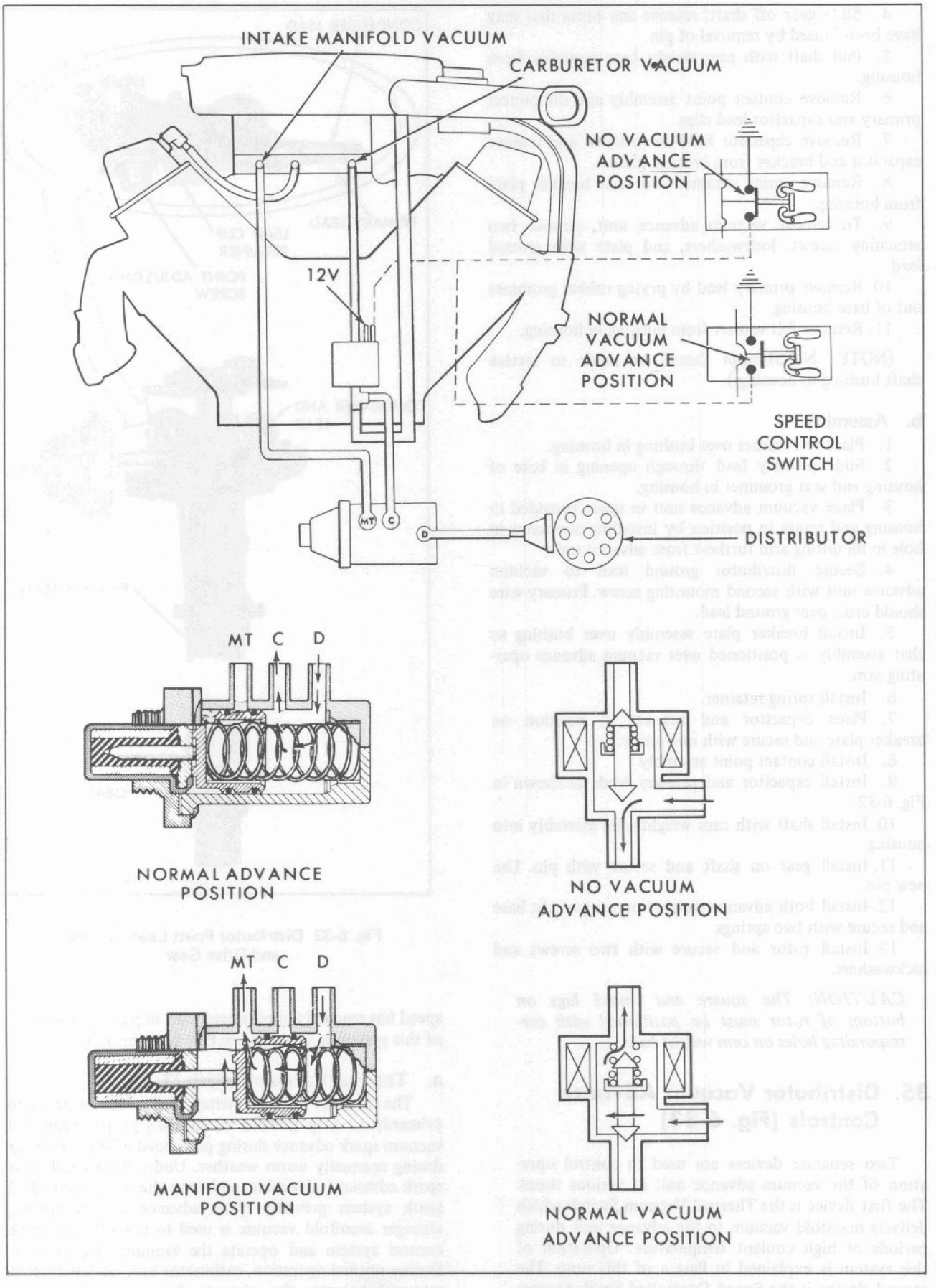


Fig. 6-33 Vacuum Advance Controls

When coolant temperature is below 220°F carburetor vacuum is supplied to the distributor vacuum advance mechanism through thermal vacuum switch connections "C" and "D", Fig. 6-33. As coolant temperature approaches 220°F, wax in the bulb expands, forcing the plunger out against the spring. When 220°F is reached, the wax has expanded enough to force the plunger against spring pressure to close off port "C" and open port "MT". Manifold vacuum, available at port "MT", is now used to operate the vacuum advance mechanism.

When coolant temperature drops below 220°F, spring pressure forces the plunger back to its normal position. This is made possible because the cooling of the wax has caused it to contract back to its normal shape. Once this operation is completed, carburetor vacuum is again used to control the spark advance unit.

When a car with this switch has overheating problems during city traffic or prolonged idle, part of the trouble could be due to an inoperative switch. If all other checks of the cooling system show the system is in order, check the vacuum switch.

b. Speed Controlled Spark Advance System

The speed controlled spark system is designed to help control exhaust emissions by shutting off vacuum to the advance unit during speeds from 0 to 33 ± 2 mph. A vacuum solenoid, mounted near the ignition coil, controls the path of vacuum in response to the speed sensor. The speed control sensor determines vehicle speed and is deactivated at 33 ± 2 miles per hour. The contacts remain closed until 33 ± 2 miles per hour providing a complete circuit from the battery through the vacuum solenoid to the speed control sensor which is grounded. The complete circuit activates the vacuum solenoid moving the valve against spring pressure to close off the vacuum supply to the advance unit. In this position the advance unit is vented to atmosphere through the hose at the rear of the carburetor.

The above action is illustrated in Fig. 6-33, as the "no vacuum advance position." When car speed reaches 33 ± 2 miles per hour the contacts inside the speed control sensor separate, thus breaking the circuit and de-energizing the solenoid. With no current available at the solenoid, spring pressure forces the valve off of the vacuum port. The normal carburetor vacuum signal is now available to the distributor vacuum advance unit. This action is illustrated in Fig. 6-33 as the "normal vacuum advance position." When car speed is reduced for any reason below 25 mph, the contacts inside the speed control sensor close and return the vacuum solenoid to the "no vacuum advance" position.

It should be noted that the speed controlled spark system regulates only carburetor vacuum and does not affect operation of the Thermal Vacuum Switch in its manifold supply position.

ENGINE TUNE-UP

Figure 6-15 illustrates the basic instrumentation required to perform the following tune-up procedures. If further testing is required such as coil tests, condenser tests, or cylinder leakage tests, the equipment manufacturer's recommendations, supplied with the test equipment to be used, should be followed for procedures. The specifications for such tests appear on page 6-53 of this manual.

The basic connections shown in Fig. 6-15 are as follows:

1. Voltmeter
   a. Positive lead to positive battery post.
   b. Negative lead to ground.
2. Timing Light
   a. Positive lead to positive battery post.
   b. Negative lead to ground.
   c. Trigger lead to No. 1 spark plug, either at plug or distributor cap. No. 1 spark plug is the front cylinder on the right (passenger) side of engine.
3. Tachometer and Dwell Meter
   a. Positive lead to distributor side of coil.
   b. Negative lead to ground.

36. Distributor Contact Points

a. Inspection

Remove distributor cap by inserting a screwdriver in upper slotted end of cap retainers, press down and turn until latches are disengaged, Fig. 6-30.

Pitted or oxidized points should be replaced. Contact points with an oily surface should be inspected for pitted or oxidized condition. The source of oil should be located and corrected. If the points are worn evenly and show a uniform gray surface, they do not need attention, provided the dwell angle is within limits (28° to 32°).

b. Removal

1. Remove distributor cap, Fig. 6-30.
2. Remove two screws that secure rotor cap to distributor and remove cap.
3. Remove capacitor lead and primary lead from nylon insulated connection.
4. Loosen two screws that hold base of contact set assembly in place, and remove contact points.
5. Inspect condition of advance weights. If necessary, add a small amount of cam and bearing lubricant to the advance weights.

c. Installation

1. Rotate distributor cam lubricator 1/2 turn at first, third, etc. tune-ups. Replace lubricator at second, fourth, etc. tune-ups.
2. Lubricate the distributor cam lubricator (if not replaced) with a small amount of distributor cam lubricant part number 1948792 or equivalent.

3. Position replacement points under the two screws and tighten screws.

4. Install capacitor lead, primary lead and secure with spring clip retainer, Fig. 6-32.

(NOTE: Leads must be properly positioned, as shown in Fig. 6-32, to eliminate interference between cap, weight base, and breaker advance plate.)

5. Install rotor cap and secure with two attaching screws, Square and round lugs on the bottom of the rotor must be aligned with corresponding holes on cam weight base.

6. Position distributor shaft so that contact arm rubbing block rests on one lobe of distributor cam.

7. Insert short end of 1/8 inch Allen wrench into head of adjusting screw and turn clockwise until points close. Then turn screw counterclockwise 1/2 turn.

8. Replace distributor cap.

9. Adjust contact points as outlined, Note 37.

37. Adjustment of Contact Points—Engine Running at Idle

a. Preferred Method

1. Connect a dwell meter to distributor primary lead, Fig. 6-15.

2. Lift adjustment window and insert short end of 1/8" Allen wrench into lead of adjusting screw, Fig. 6-34.

3. Turn adjusting screw until 30° dwell angle is obtained as measured by dwell meter.

4. Last adjustment should be made by turning clockwise, in order to maintain a more uniform gap.

(NOTE: It is unnecessary to check point gap, because of close manufacturing tolerances. The gap will be correct if the dwell angle is 30°.)

b. Alternate Method

1. Lift adjustment window and insert short end of 1/8" Allen wrench into head of adjusting screw, Fig. 6-34.

2. Turn adjusting screw in (clockwise) until engine begins to misfire.

3. Turn wrench 3/4 turn (270°) in opposite direction (counterclockwise), and then turn clockwise 1/4 turn (90°) to obtain proper gap and dwell.

38. Ignition Timing Adjustment

1. Adjust distributor clamp nut to allow distributor to be turned by hand, but without excessive looseness.

2. Disconnect vacuum advance unit hose at distributor and place a piece of tape over end of hose. This is important, as a manifold leak will affect timing adjustments.

3. Disconnect parking brake vacuum hose at diaphragm and place a piece of tape over end of hose to prevent any air leak.

4. Insert an adapter pin alongside No. 1 or No. 4 ignition wire in distributor cap, if spark plug connectors are not available.

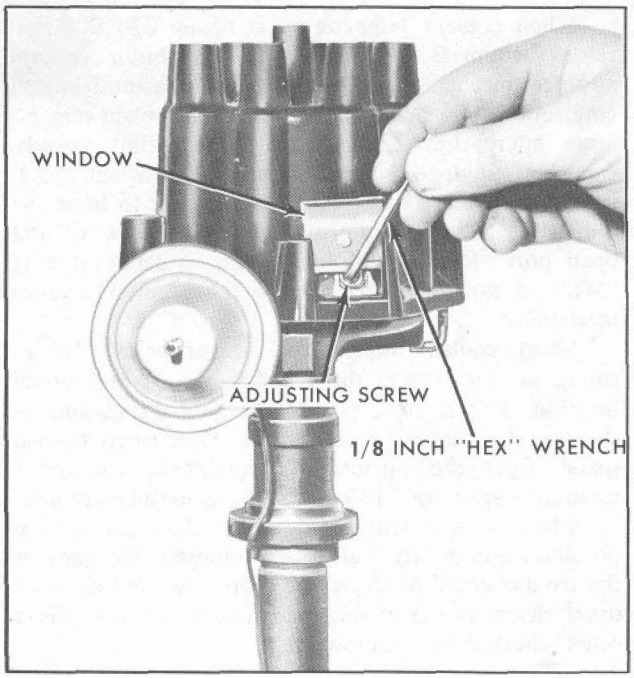


Fig. 6-34 Adjusting Distributor Point Dwell

5. Connect a suitable timing light to adapter or connector.

(NOTE: Make sure that timing marks and scribe marks are clean.)

6. Connect tachometer, Fig. 6-15, to engine and set parking brake securely. Place transmission selector lever in neutral or park position.

7. Start engine and warm to operating temperature.

8. Set idle speed at 600 rpm with transmission selector lever in "DRIVE" position.

9. Observe timing light flashes on pulley in relation to notches on front cover. Set timing to 8.0 degrees ahead of top dead center, Fig. 6-35.

10. Tighten clamp nut to 18 foot-pounds, and recheck timing to make sure that it did not change.

11. Remove tape from vacuum advance hose and connect hose to vacuum advance unit.

12. Remove tape from parking brake vacuum hose and connect hose to parking brake diaphragm.

13. Disconnect tachometer and timing light, and remove adapter pin or connector from engine.

39. Spark Plug Cleaning and Adjustment

Type R-46-N spark plugs are used on all 1972 engines.

The conditions of the compound in the spark plug cleaner is important. It must be dry, because if moist, it could pack in the space between the insulator tip and shell, allowing only the tip of the plug to be cleaned. Also, the compound must be sharp to do a good cleaning job. After prolonged use, the particles of compound lose their sharp cutting edges and will not clean properly.

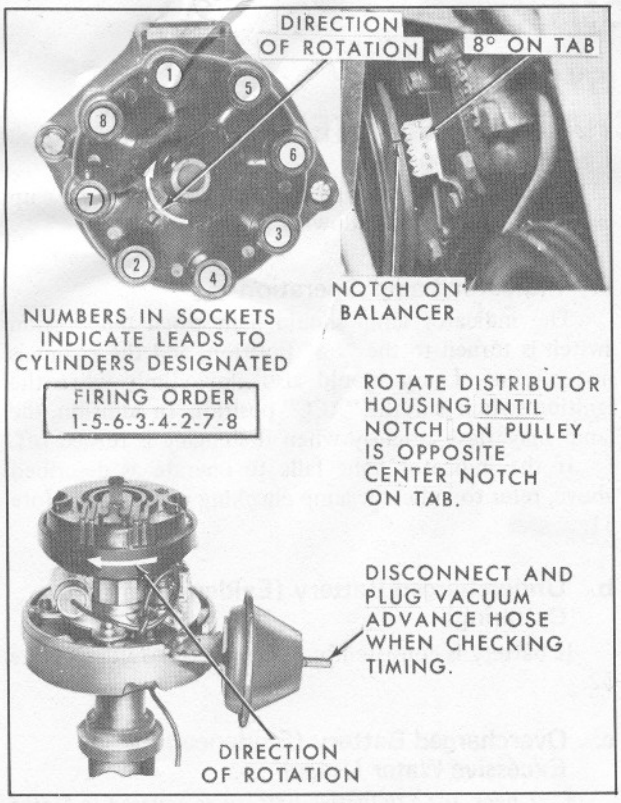


Fig. 6-35 Ignition Timing Adjustment

With the spark plug in the cleaner and the air blast turned on, press the cleaner hood down, rocking the plug. Raise the cleaner hood to the air blast position for a few seconds. Rotate the plug in its adapter and repeat the operation until the entire insulator is clean (white). It should be noted here that some spark plugs may have fused deposits on the lower insulator tips that are difficult, if not impossible, to remove. Make sure that all cleaning compound is removed from the plug.

File electrodes flat and set gap to .035 inch. The gap should be checked only with a round wire gage. Use new gaskets when installing plugs, and tighten to 25 foot-pounds.

40. Inspect Crankcase Ventilator System

The crankcase ventilation system should be checked for cleanliness. Hoses and fitting should be cleaned or replaced if any defective conditions exist. The ventilator valve should be replaced as described in Note 97. The crankcase ventilating breather should be cleaned at each engine oil change. See Section 0, Note 5c. for further information.

41. Carburetor Air Cleaner

The carburetor air cleaner element should be replaced following procedures in Section 0, Note 3B to assure proper air delivery to the engine.

42. Inspect Fuel System

The fuel system should be inspected for signs of leakage. Tighten any joints that are loose and replace hoses and lines that have been damaged.

43. Adjust Drive Belts

The drive belts should be inspected and adjusted as described in Note 10.

44. Carburetor Adjustments

The carburetor adjustments should be checked according to Notes 75 through 82.

45. Bolt Tightening

With the engine shut off, check the tightness of the following bolts and screws:

Cylinder Head Screws	115 foot-pounds
Intake Manifold Screws	30 foot-pounds
Carburetor to Manifold Screws	14 foot-pounds
Exhaust Manifold Screws	35 foot-pounds

46. Fluid Level Check

1. Check master cylinder reservoir for proper level, fluid should be 1/4 inch below top of reservoir.
2. Check power steering pump fluid level, should be at full mark on dipstick.
3. Check battery cell level, should be at bottom of filler wells.
4. Check level of coolant in reservoir. Should be between ADD and FULL marks. Check coolant for freeze protection, should be at least -40°F.
5. Check engine oil and adjust to proper level or change as required.
6. Check transmission fluid level as indicated in Section 7, Note 6B or Note 24B.

47. Visual Inspection

Visually inspect engine compartment for signs of substandard conditions. Repair conditions found. Make sure all tools are removed and instrumentation is disconnected.

48. Additional Tests

Additional tests as required should be performed following either the procedure found in the appropriate section of this manual or if no procedure is found, follow equipment manufacturer's recommendations. Specifications for such tests are found at the back of the appropriate section of this manual.

DIAGNOSIS

CHARGING SYSTEM (WITHOUT INTEGRAL CHARGING SYSTEM)

The following information should be used when diagnosing the charging circuits on 1972 Cadillac vehicles. All 1972 Cadillacs use a separate generator-regulator system except Eldorado, Limousine and Commercial Chassis vehicles which use an integral generator-regulator package. In addition an optional heavy duty generator and integral regulator is available only on the Commercial Chassis.

When describing one of these three differing charging systems, the following reference will be used.

Separate generator-regulator–(Without Integral Charging System)

Integral generator-regulator–(With Integral Charging System)

Optional heavy duty generator on Commercial Chassis–(With H.D. Generator)

49. Charging Circuit Precautions—Applies to All Charging Systems

CAUTION: When performing any tests or adjustments on the charging circuit there are certain precautions that must be observed or serious damage will result to the electrical equipment.

1. Do not attempt to "polarize" the generator.
2. Do not short across or ground any of the terminals on generator or regulator.
3. Never operate generator on open circuit. Make certain all connections are secure.
4. Make certain ground polarity of battery and ground polarity of generator are the same when installing a battery.
5. When connecting a booster battery, connect the positive terminals together and the negative cable between the boosters' negative terminal and a good engine ground point.
6. When connecting a charger to battery, connect charger positive lead to battery positive terminal first, then connect negative lead to battery negative terminal.
7. When recharging battery in the vehicle, be sure engine is turned off when battery terminal connections are made. This will prevent arcing at the terminals which could cause an explosion at the battery.
8. Make sure all electrical accessories are turned off when making battery connections.

50. Analyzing Charging System Troubles

Visually check the charging circuit for the following:

1. Frayed insulation or wiring.
2. Tightness of mounting bolts.
3. Corroded or loose connections at generator terminals and slip-on connectors at regular terminals.

Trouble in the charging system, will usually show up as one or more of the following conditions:

a. Indicator Lamp Operation

The indicator lamp should light when the ignition switch is turned to the "on" position, and the engine is not running. Lamp should also glow dimly when the ignition switch is in the "ACC" position. In addition, the lamp may flash brightly when the engine is turned off.

If the indicator light fails to operate as described above, refer to indicator lamp checking procedures, Note 51.

b. Undercharged Battery (Evidenced by Slow Cranking)

If battery is consistently undercharged, refer to Note 52.

c. Overcharged Battery (Evidenced by Excessive Water Usage)

1. Check for a defective battery as covered in Notes 11 through 14.
2. If battery is not defective, voltage regulator setting is probably too high. Refer to Note 55.

51. Testing Indicator Lamp Circuit

a. Lamp Does Not Light With Ignition In "ON" Position

1. Disconnect wiring harness connector at regulator.
2. Insert jumper lead, J-9782-1, into wiring harness and connect as shown in Fig. 6-36.
3. Turn ignition switch "ON" for not more than 10 seconds. Generator light should light.

CAUTION: With these connections made for longer than 10 seconds, damage to the 20 ohm resistance wire may result.

4. If lamp does not glow, check for a burned out bulb, defective #4 terminal wire, or a defective printed circuit as described in Section 12, Note 49.
5. If lamp does glow, remove ground and connect as shown in Fig. 6-37.
6. If lamp glows, adjust voltage regulator setting or replace regulator if adjustment is not possible. If lamp does not glow, leave connections as shown in Fig. 6-37 but connect a second jumper wire from generator "F" terminal to ground.
7. If lamp does not glow, "F" terminal lead is open. If lamp glows, field circuit inside generator is open.

b. Lamp Glows When Ignition Switch is "OFF"

1. Unplug connector at rear of generator; if lamp goes out, generator has a shorted diode.

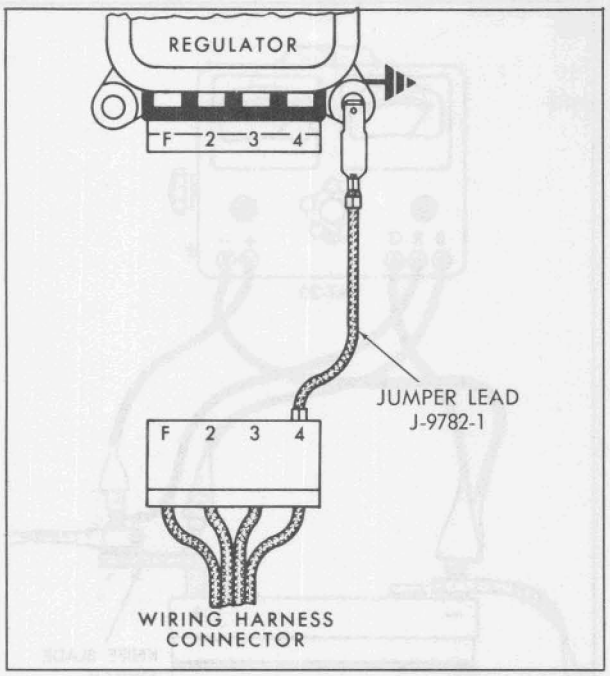


Fig. 6-36 Testing Indicator Lamp Circuit

2. If lamp does not go out, make normal connections at generator and remove wiring connector from regulator.

3. If lamp still does not go out, look for a short between #4 lead and #3 lead (or any other lead with battery voltage).

4. If lamp does go out, connect a voltmeter between #2 harness terminal and ground. Any voltage reading indicates that #2 regulator lead is shorted to #3 lead (or another lead with battery voltage). No voltage reading indicates a field relay is mechanically stuck closed.

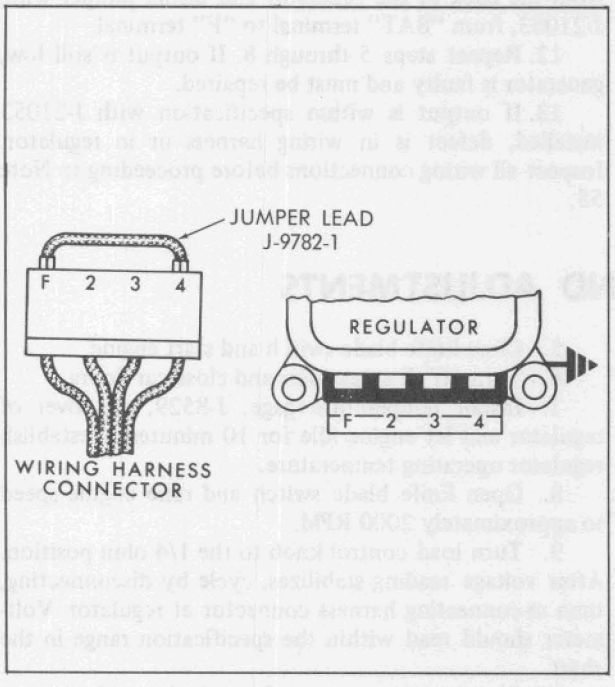


Fig. 6-37 Testing For Opens In Circuit

c. Lamp Glows With Engine Operating At Idle Speed

The possible causes of this condition are covered in Note 52, steps 1, 3, 4 and 5.

(NOTE: If defect has been found and corrected at this point, no further checks are necessary.)

52. Testing Undercharged Battery Condition

This condition, as evidenced by slow cranking, can be caused by one or more of the following conditions even though the indicator lamp may be operating normally.

1. Check generator drive belt for frayed, worn or loose condition. Adjust belt as outlined in Note 10.

2. If a battery defect is suspected, check as described in Notes 11 through 14.

3. Inspect all connections to be sure they are clean and tight, including the slip connectors at the generator, regulator and firewall. Make sure that the regulator is properly grounded. Inspect the wiring harness for grounds. Clean the battery posts and cable clamps to eliminate resistance. Check with ignition switch on as follows:

a. With harness connector attached to regulator, slide test prod into regulator No. 3 terminal, and connect voltmeter from test prod to ground.

b. If reading is zero, circuit is open between this terminal and battery.

c. Connect voltmeter from generator "F" terminal to ground.

d. If a voltage reading is obtained, proceed to Step 4.

e. If reading is zero, connect voltmeter from regulator "F" terminal to ground.

f. If reading is obtained, "F" terminal lead is open.

g. If reading is zero, connect voltmeter from regulator No. 4 terminal to ground.

h. If reading is obtained, adjust regulator voltage setting or replace regulator if adjustment is not possible.

i. If reading is zero, circuit is open between regulator No. 4 terminal and Ignition Switch.

4. Connect voltmeter from regulator No. 4 terminal to ground. Turn Ignition Switch to "ACC" position. If reading is zero, resistor connected to "ACC" terminal is open.

5. If the indicator lamp operates normally, checks need not be made on the field relay; go to Note 53. However, if the indicator lamp fails to go out with the generator in operation, check the field relay as follows:

a. Connect a voltmeter from regulator No. 2 terminal to ground.

b. Operate engine slightly above idle speed.

c. If voltmeter reads 5 volts or above and the indicator lamp fails to go out, replace regulator.

d. If reading is below 5 volts, connect voltmeter from generator "R" terminal to ground.

e. If reading now is 5 volts or above, lead between generator "R" terminal and regulator No. 2 terminal is defective.

f. If reading is still below 5 volts, proceed to Note 54.

53. Testing Overcharged Battery Condition

An overcharged battery, as evidenced by excessive water usage of over two ounces per cell per month, is caused by:

1. Defective Battery: If a defective battery is suspected, check as described in Notes 11 through 14.

2. Poor Circuit Connections: Inspect all connections to make sure they are clean and tight, particularly the circuit between the battery and regulator No. 3 terminal, and the regulator ground.

3. High Voltage Regulator Setting: If no circuit defects are found, yet the battery remains overcharged, proceed to Note 55 - "Adjusting Voltage Regulator Setting".

54. Generator Output Test (Fig. 6-38)

1. Disconnect positive battery cable.

2. Install knife blade switch between battery positive post and battery cable terminal.

3. Connect VAT-20 as follows:

a. Set ground polarity switch to negative position.

b. Set load control to direct position.

c. Connect BAT lead of ammeter to knife blade switch terminal stud and connect REG lead to positive battery cable on the knife blade switch, Fig. 6-38.

d. Connect ammeter GRD terminal to negative battery terminal, Fig. 6-38.

4. Disconnect the feed wire from the heater or A/C blower motor.

5. Close knife blade switch and start engine.

6. Turn off all accessories and close car doors.

7. Open knife blade switch and raise engine speed to approximately 2000 RPM.

8. Adjust load control for highest ammeter reading.

9. Reading should be within 10 amps of rated output of generator.

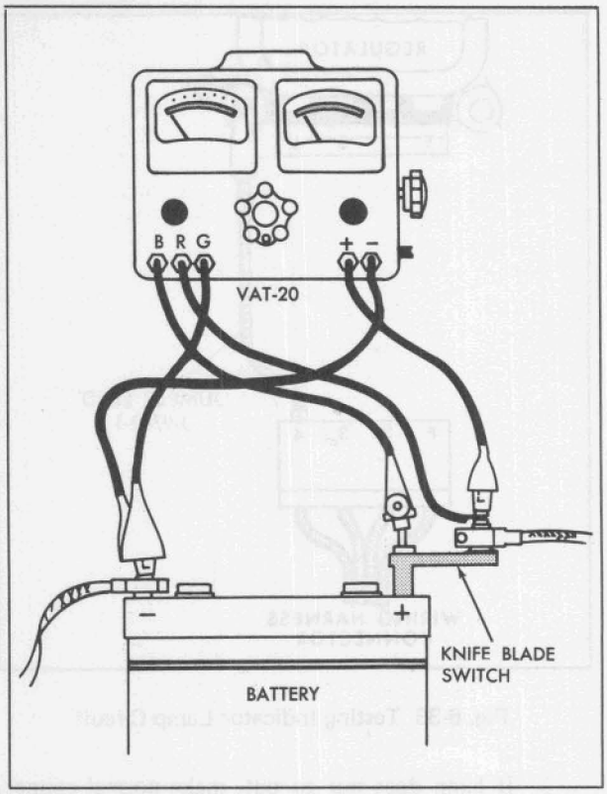


Fig. 6-38 Charging Circuit Test

(NOTE: High underhood temperatures may cause amperage reading to be slightly lower than rated.)

10. If generator output is within specification proceed to Note 55.

11. If output is low, remove the wiring connector from the back of the generator and install jumper wire, J-21053, from "BAT" terminal to "F" terminal.

12. Repeat steps 5 through 8. If output is still low, generator is faulty and must be repaired.

13. If output is within specification with J-21053 installed, defect is in wiring harness or in regulator. Inspect all wiring connections before proceeding to Note 55.

REGULATOR TESTS AND ADJUSTMENTS

55. Checking and Adjusting Voltage Regulator Setting (Without Integral Charging System)

1. Test generator output as described in Note 54.

2. Leave test instrumentation connected as described in Note 54, Steps 1-3. Remove field jumper wire, J-21053, if used.

3. Set voltage switch to 16 volts position.

4. Connect negative voltmeter lead of VAT-20 to the negative battery terminal and the positive voltmeter lead to the positive battery cable on the knife blade switch, Fig. 6-38.

5. Close knife blade switch and start engine.

6. Turn off all accessories and close car doors.

7. Install temperature gage, J-8529, on cover of regulator and let engine idle for 10 minutes to establish regulator operating temperature.

8. Open knife blade switch and raise engine speed to approximately 2000 RPM.

9. Turn load control knob to the 1/4 ohm position. After voltage reading stabilizes, cycle by disconnecting, then re-connecting harness connector at regulator. Voltmeter should read within the specification range in the chart.

10. Connect a jumper wire from the base of the regulator unit to a good ground and note voltage reading.

If voltage reading changes when regulator base is temporarily grounded, regulator is poorly grounded and voltage reading is inaccurate. Correct situation before taking final voltage reading.

Regulator Temperature	Voltage	
	Low	High
185°F	13.1	13.9
165°F	13.2	14.0
145°F	13.4	14.2
125°F	13.5	14.4
105°F	13.7	14.6
85°F	13.8	14.8
65°F	13.9	15.0

11. If voltage reading is incorrect, detach regulator harness connector, remove cover, reconnect harness connector.

12. Turn adjusting screw as shown in Fig. 6-39.

13. For undercharged battery raise setting to upper part of specification range.

14. For overcharged battery lower setting to lower part of specification range.

(NOTE: Always make final setting by turning screw clockwise. This insures that spring holder will be against head of screw. If it is necessary to turn screw counterclockwise, turn until screw head is approximately 1/8 inch above adjusting bracket, then pry holder up against screw head and turn clockwise to make setting.)

15. After making setting, cycle by disconnecting then reconnecting harness connector at regulator.

16. Operate engine at 2000-2200 rpm and note setting. Re-adjust if necessary. Always cycle (Step 15) before reading final voltage setting.

17. This procedure has adjusted the setting while operating on the upper or shorting contacts. Proceed to adjust the setting in the lower or series contacts as follows.

18. Slowly decrease engine speed from the 2000-2200 rpm value and observe voltmeter. When operation changes from upper to lower contacts, voltmeter reading should suddenly decrease between .1 and .3 tenths of a volt.

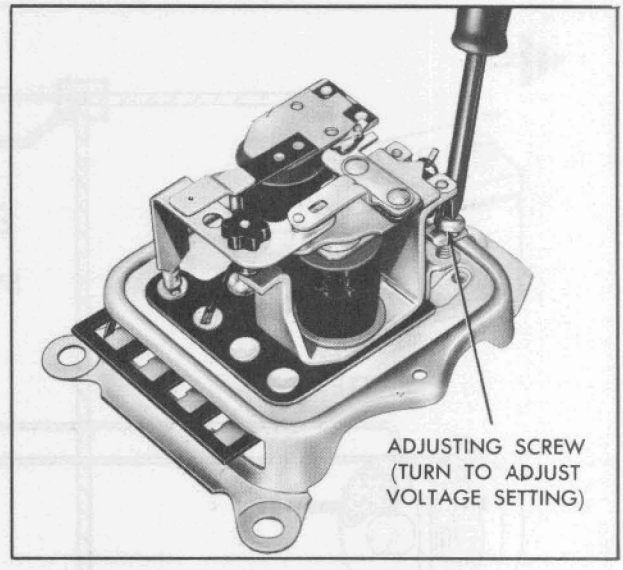


Fig. 6-39 Adjusting Voltage Regulator Setting

19. To decrease the difference in voltage between upper and lower contact operation, turn the nylon nut, Fig. 6-39, clockwise a slight amount. To increase the difference, turn nylon nut counterclockwise. If this adjustment is made, the voltage setting must be re-checked as covered in Steps 12 through 18.

CAUTION: Do not attempt to check regulator except when mounted on car and properly grounded. Operation without ground will destroy regulator.

20. If voltage operation is erratic, and if the regulator cannot be adjusted to a steady value, replace the regulator.

CAUTION: Always remove harness connector at regulator when removing or replacing cover to avoid accidental grounds and consequent damage to regulator.

DIAGNOSIS

CHARGING SYSTEM (WITH INTEGRAL CHARGING SYSTEM)

56. Analyzing Charging System Troubles

Close adherence to the following procedures in the order presented will lead to the location and correction of integral charging system defects in the shortest possible time. Only a portion of these procedures need be performed. It will never be necessary to perform all the procedures in order to locate the trouble.

A basic wiring diagram showing lead connections is shown in Fig. 6-40. To avoid damage to the electrical equipment, always observe the following precautions:

- Do not polarize the generator.
- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed herein.
- NEVER operate the generator with the output terminal open-circuited.
- Make sure the generator and battery have the same ground polarity.

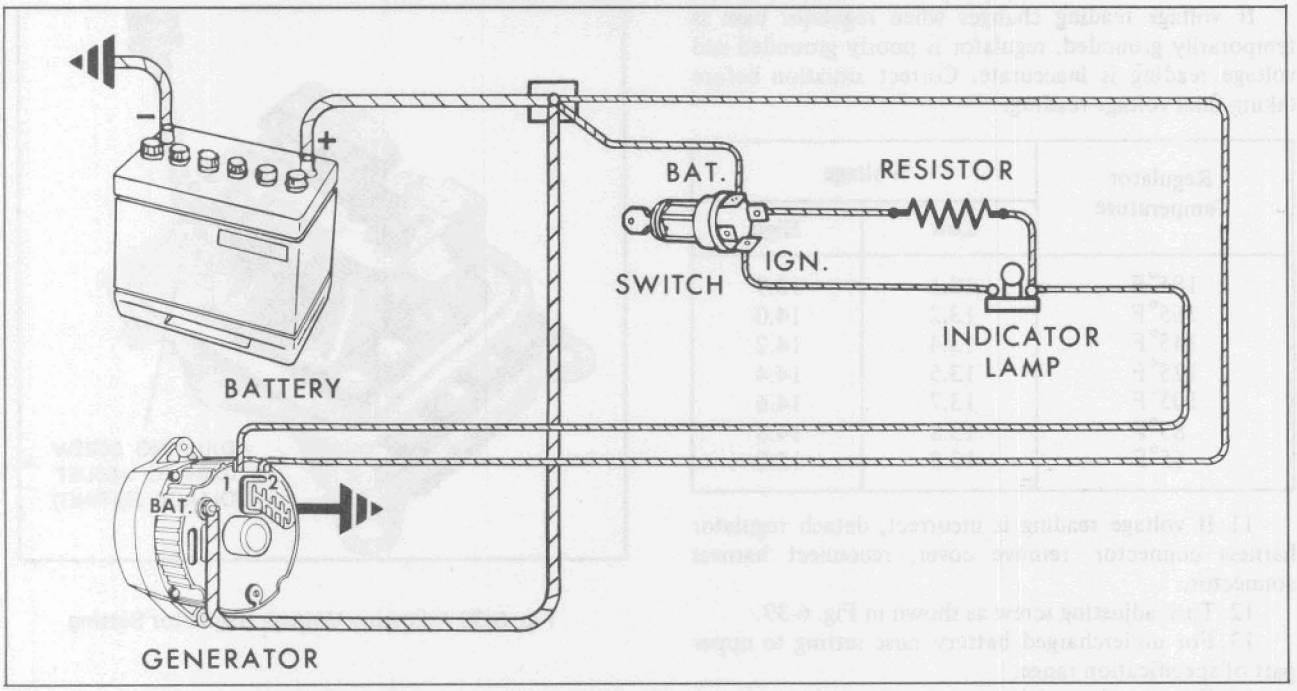


Fig. 6-40 Basic Wiring Diagram

• When connecting a charger or a booster battery to the vehicle, connect negative to negative and positive to positive.

Trouble in the charging system will show up as one or more of the following conditions:

A. Faulty indicator lamp operation.

B. An undercharged battery as evidenced by slow cranking and low specific gravity readings.

C. An overcharged battery as evidenced by excessive water usage.

a. Faulty Indicator Lamp Operation

Check the indicator lamp for normal operation as shown below.

Switch	Lamp	Engine
OFF	OFF	STOPPED
ON	ON	STOPPED
ON	OFF	RUNNING

If the indicator lamp operates normally, proceed to "Undercharged battery" or "Overcharged battery" section. Otherwise, proceed to either one of the following three abnormal conditions.

1. Switch Off, Lamp On–In this case, disconnect the two leads from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the rectifier bridge as described in Note 60c. This condition will cause an undercharged battery.

2. Switch On, Lamp Off, Engine Stopped–This condition can be caused by the defects listed in Part 1 above, by reversal of the No. 1 and No. 2 leads at these two terminals, or by an open in the circuit. This condition can cause an undercharged battery. To determine where an open exists, proceed as follows:

a. Connect voltmeter from No. 2 generator terminal to ground. If reading is obtained, go to Step b. If reading is zero, check for open circuit between No. 2 terminal and battery. If no open circuit is found, check connection between wiring harness and No. 1 terminal of generator, and check brushes, slip rings, and field winding for opens as described in Note 60. If open circuit is still not found, replace regulator.

b. With ignition switch on and with No. 1 and No. 2 terminal leads connected, or disconnected, at generator, momentarily ground No. 1 terminal lead.

CAUTION: Do not ground No. 2 lead.

c. If lamp does not light, check for a blown fuse, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.

d. If lamp lights, remove ground at No. 1 terminal and with No. 1 and No. 2 terminal leads connected at generator insert screwdriver into test hole, Fig. 6-41, to ground field winding.

e. If lamp does not light, check connection between wiring harness and No. 1 terminal of generator, and check brushes, slip rings, and field winding for opens as described in Note 60.

f. If lamp lights, and voltmeter reading is obtained in Step a preceding, replace regulator as described in Note 60e and check field winding.

3. Switch On, Lamp On, Engine Running–The possible causes of this condition are described in Part b of this Note 52.

If a defect has been found and corrected at this point, no further checks need be made.

b. Undercharged Battery

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions even though the indicator lamp may be operating normally.

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery defect is suspected, refer to battery diagnosis, Notes 11 through 14.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and firewall, and the cable clamps and battery posts and terminals.
5. With ignition switch on and all wiring harness leads connected, connect a voltmeter from:
   a. generator "BAT" terminal to ground
   b. generator No. 1 terminal to ground
   c. generator No. 2 terminal to ground

A zero reading indicates an open between voltmeter connection and battery.

6. If previous Steps 1 through 5 check satisfactorily, check generator as follows:
   a. Disconnect positive battery cable.
   b. Install knife blade switch between battery positive post and battery cable terminal.

(NOTE: Two battery terminal adapters are required to perform this operation on the side terminal battery used on Eldorado models. These adapters are available from several equipment manufacturers and their instructions for use should be followed.)

   c. Connect VAT-20 as outlined in Note 54, Steps 3 and 4.
   d. Close knife blade switch and start engine.
   e. Turn off all accessories and close car doors.
   f. Open knife blade switch and raise engine speed to approximately 2000 RPM.
   g. Adjust load control for highest ammeter reading.
   h. If ampere output is within 10 percent of rated output as stamped on generator frame, generator is not defective; recheck Steps 1 through 5.
   i. If ampere output is not within 10 percent of rated output, ground the field winding by inserting a screwdriver into the test hole, Fig. 6-41.

CAUTION: Tab is within 3/4 inch of casting surface. Do not force screwdriver deeper than one inch into end frame.

   j. Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.
   k. If output is within 10 percent of rated output, replace regulator as described in Note 60e, and check field winding.
   l. If output is not within 10 percent of rated output, check the field winding, diode trio, rectifier bridge, and stator as described in Note 60.
   m. Turn off engine and remove equipment from vehicle.

c. Overcharged Battery

1. To determine battery condition, proceed as follows:
2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open.

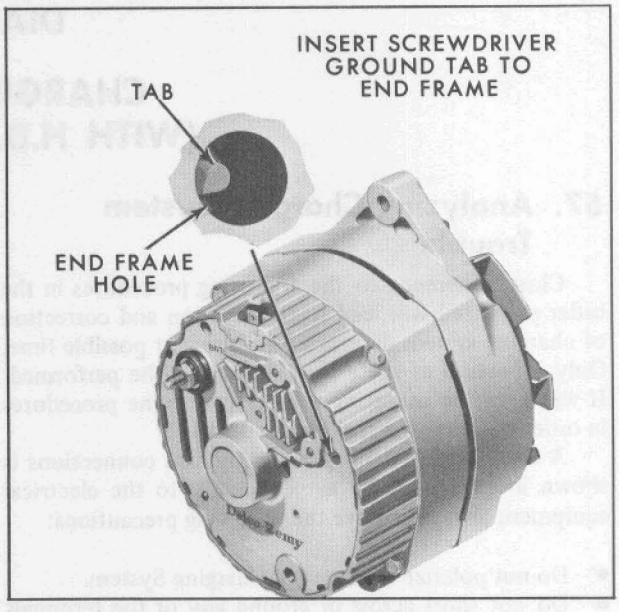


Fig. 6-41 Grounding Generator Field Winding

3. If battery and No. 2 lead circuit check good, but an obvious overcharge condition exists as evidenced by excessive battery water usage, proceed as follows:
   a. Separate end frames as described in Note 59a.

Check field winding for shorts. If shorted replace rotor and regulator.

   b. Connect ohmmeter using lowest range scale from brush lead clip to end frame as shown in Step 1, Fig. 6-42, then reverse lead connections.
   c. If both readings are zero, either the brush lead clip is grounded or regulator is defective.
   d. A grounded brush lead clip can result from omission of insulating washer, Fig. 6-42, omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If satisfactory, replace regulator as described in Note 60e.

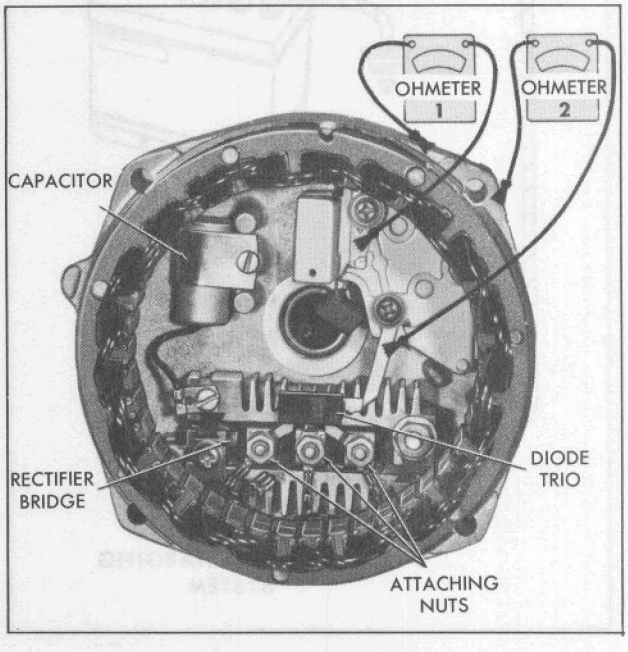


Fig. 6-42 Slip Ring End Frame Assembly

DIAGNOSIS

CHARGING SYSTEM (WITH H.D. GENERATOR)

57. Analyzing Charging System Trouble

Close adherence to the following procedures in the order presented will lead to the location and correction of charging system defects in the shortest possible time. Only a portion of these procedures need be performed. It will never be necessary to perform all the procedures in order to locate the trouble.

A basic wiring diagram showing lead connections is shown in Fig. 6-43. To avoid damage to the electrical equipment always observe the following precautions:

- Do not polarize the Integral Charging System.
- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed herein.
- Make sure the Integral Charging System and battery have the same ground polarity.
- When connecting a charger or a booster battery to the vehicle battery, connect negative to negative and positive to positive.

Trouble in the charging system will show up as one or more of the following conditions:

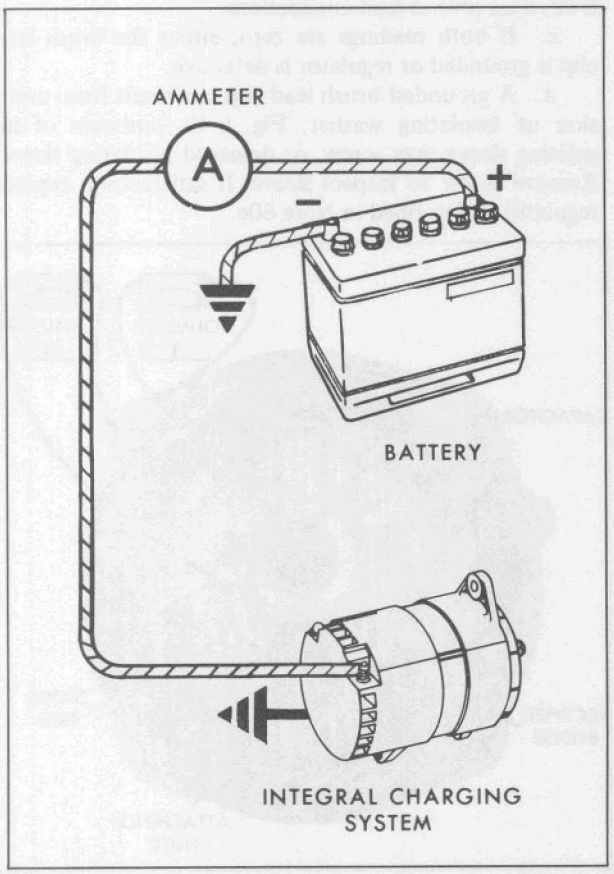


Fig. 6-43 Wiring Diagram - Heavy Duty Generator

a. Undercharged Battery

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions:

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery defect is suspected, proceed with checks.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the cable clamps and battery posts.
5. Connect a voltmeter from "BAT" terminal on Integral Charging System to ground. A zero reading indicates an open between voltmeter connection and battery.
6. If previous Steps 1 through 5 check satisfactorily, check Integral Charging System as follows:
7. Disconnect positive battery cable.
8. Install knife blade switch between battery positive post and battery cable terminal.
9. Connect VAT-20 tester as follows:
   a. Set ground polarity switch to negative position.
   b. Set load control to direct position.

   Connect BAT lead of ammeter to knife blade switch terminal stud and connect REG lead to positive battery cable on the knife blade switch, Fig. 6-38.
   d. Connect ammeter GRD terminal to negative battery terminal, Fig. 6-38.
10. On air conditioned cars, disconnect the 18T wire from the blower motor.
11. Close knife blade switch and start engine.
12. Turn off all accessories and close car doors.

CAUTION: The following specifications are critical and given values must be adhered to.

13. Open knife blade switch and raise engine speed to 750 rpm.
14. Adjust load control for highest ammeter reading.
15. Reading should be 95 amps, plus or minus 10 percent.

CAUTION: In no case should the meter be allowed to exceed its 100 amp. limit.

16. If reading given in Step 15 is correct, generator is functioning normally. In this case, an adjustment of the voltage setting may correct the undercharged condition. Raise the setting by removing the voltage adjusting cap, rotating in increments of 90°, and then re-inserting the cap in the connector body. As illustrated in Fig. 6-44, the cap is set for low voltage. With position 2 aligned with the arrow, the setting is increased to medium low, position 3 is medium high, and position "HI" is the highest regulator setting. After adjusting the setting, check for an improved battery condition after a service period of reasonable length, such as one week.

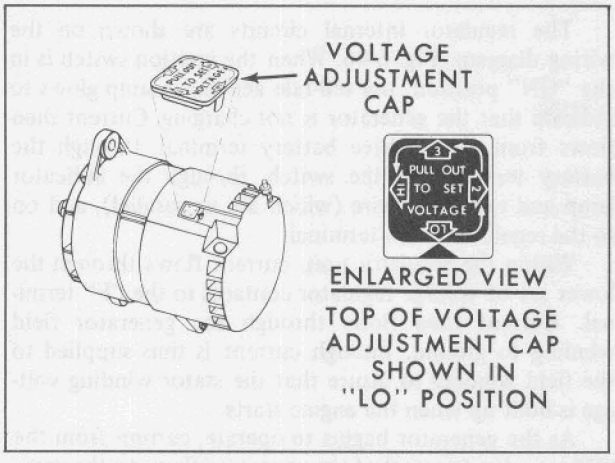


Fig. 6-44 Voltage Adjustment Cap

(NOTE: The voltage adjustment in Fig. 6-44, is for purposes of illustration only. The actual adjustment as shipped from the factory may be in some other position such as position 3, depending on the application requirement.)

(NOTE: High underhood temperatures may cause amperage reading to be slightly lower than rated.)

17. If reading obtained is not correct, record amps for future reference and remove generator for repair as covered in Note 60.

b. Overcharged Battery

1. Check the battery. Remember that an overheated battery will be overcharged even though no charging circuit defects are present.

2. If battery is not defective or overheated, connect a voltmeter between Integral Charging System "BAT" terminal and ground.

3. With all accessories turned off, increase engine speed as required to obtain maximum voltage reading.

4. If voltage exceeds 15 volts, remove Integral Charging System for repair as described in Note 60.

5. If voltage does not exceed the values listed in Step 4 preceding, adjust voltage to a lower value by removing voltage adjusting cap and re-inserting into connector body. Then check battery condition after a service period of reasonable length, such as one week. Fig. 6-44 is for purposes of illustration only, and shows the cap adjusted for the lowest setting. The actual adjustment as shipped from the factory may be in some other position, such as position 3, depending on the application requirement. The lowest setting is with "LO" aligned with the arrow, position 2 is medium low, position 3 is medium high, and "HI" is the highest setting.

THEORY OF OPERATION

The following information describes the charging circuits used on 1972 Cadillac vehicles. All 1972 Cadillacs use a separate generator-regulator system except Eldorado, Limousine and Commercial Chassis vehicles which use an integral generator-regulator package. In addition an optional heavy duty generator and integral regulator is available only on the commercial chassis.

When describing one of these three differing charging systems, the following reference will be used.

Separate generator-regulator–(Without Integral Charging System)

Integral generator-regulator–(With Integral Charging System)

Optional heavy duty generator on commercial chassis–(With H.D. Generator)

Generator (Without Integral Charging System)

The generator is mounted on the right front of the engine. A 42 ampere generator is used on cars without air conditioning, Fig. 6-45. Cars with air conditioning are equipped with a 63 ampere generator of similar design.

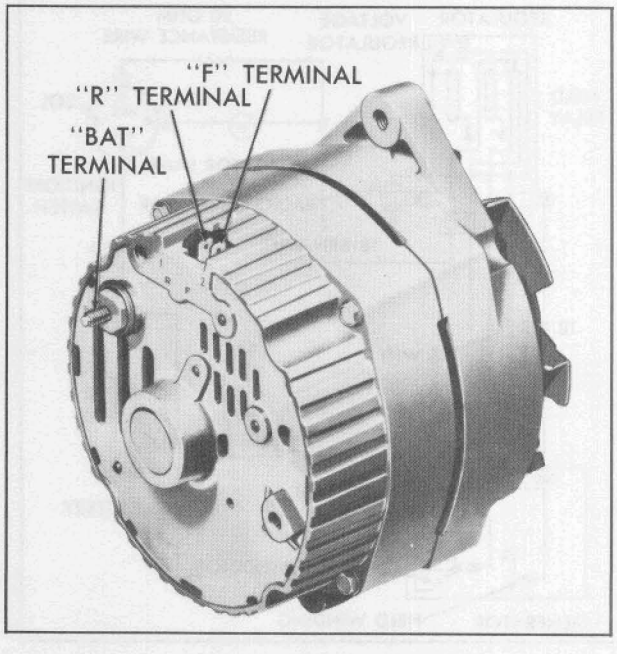


Fig. 6-45 Non-Integral Generator

These generators are of basically the same construction and consist primarily of a drive end frame, a slip ring end frame, a stator assembly and a rotor assembly. The rotor assembly is supported in the drive end frame by a ball bearing and in the slip ring end frame by a roller bearing.

The stator assembly, mounted between the two end frames, consists of loops of wire wound into the slots of the laminated stator frame. The rotor assembly contains a field coil wound on an iron spool. The coil and spool are mounted between two iron segments with interlacing poles. These parts are a press fit on the shaft. Two slip rings, upon which the brushes ride, are mounted on the rotor shaft. The brushes carry current through the slip rings to the field coil.

Six diodes are located in a rectifier bridge near the slip rings. Three of these diodes are negative and three diodes are positive. The diodes are mounted into a strip called a "rectifier bridge", which is insulated from the end frame. The six diodes form a rectifier network that changes the alternating current voltages developed in the stator windings to direct current voltage at the "BAT", or output, terminal of the generator.

Regulator (Without Integral Charging System)

The voltage regulator assembly is mounted to the engine compartment firewall behind the engine in a waterproof case.

A double contact voltage regulator and a field relay are the principal parts of this assembly. The voltage regulator unit limits the voltage output. The field relay unit connects the generator field winding and regulator winding to the battery.

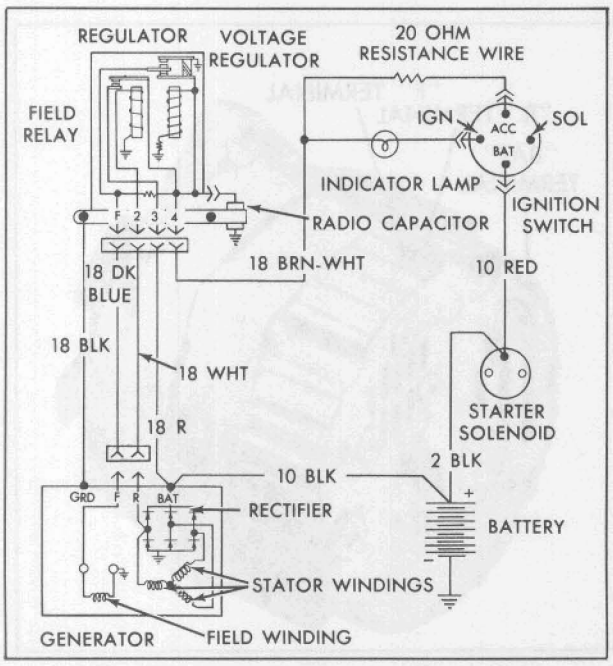


Fig. 6-46 Basic Charging Circuit (Without Integral Regulator)

The regulator internal circuits are shown on the wiring diagram, Fig. 6-46. When the ignition switch is in the "ON" position, the tell-tale generator lamp glows to indicate that the generator is not charging. Current then flows from the positive battery terminal, through the battery terminal on the switch, through the indicator lamp and resistance wire (which are in parallel), and on to the regulator No. 4 terminal.

Within the regulator unit, current flows through the lower set of voltage regulator contacts to the "F" terminal. Current then flows through the generator field winding to ground. Enough current is thus supplied to the field winding to insure that the stator winding voltage is built up when the engine starts.

As the generator begins to operate, current from the "R" or relay terminal of the generator flows to the regulator No. 2 terminal, causing the field relay contacts to close. This connects the regulator No. 4 terminal directly to the battery through the field relay contacts, which applies system voltage to the regulator side of the tell-tale indicator lamp. With equal system voltage on the battery side of the indicator lamp, there is no current flow and the indicator lamp will go out. Generator field current then flows from the generator output terminal to the regulator No. 3 terminal and through the field relay contacts and the voltage regulator lower contacts to the field winding.

As the generator rpm increases, the voltage at the "BAT" or output terminal also increases. This impresses a higher voltage through the field relay contacts and across the voltage regulator shunt winding. The magnetic field developed in the winding causes the lower, or series, contacts of the voltage regulator to separate. The generator field current then flows to ground through a resistor that reduces field current.

This reduced field current causes the generator voltage output to decrease, thereby decreasing the magnetic pull of the voltage regulator shunt winding. A spring overcomes the weakened magnetism and closes the contacts. This cycle repeats itself many times per second to limit the generator voltage to the pre-set value.

As the generator speed increases even further, the resistor connected across the contacts is not large enough to maintain voltage control. However, when the voltage increases slightly above the setting, this causes the upper or "shorting" contacts to close. When this happens, the generator field winding is shorted so that no current passes through the winding.

With no current in the field winding, the generator voltage output decreases sharply. This reduces the magnetic field in the shunt winding and allows the upper contact points to open. With these points open, field current again flows through the resistor and the field winding. As the voltage increases, the contacts again close. This cycle repeats many times per second to limit the generator voltage to the pre-set value at high generator speeds.

The voltage regulator unit operates to limit the value of the generator voltage throughout the entire generator speed range, protecting all electrical units and accessories from too high a voltage, which could damage them. The self-limiting current output feature of the generator eliminates the need for a current regulator.

The regulator used with the 63 amp generator has a field discharge diode from lower contact to ground allowing higher field current through contacts with subsequent higher output. This regulator is not interchangeable with any other regulator.

Generator (With Integral Charging System)

The Eldorado, Limousine and Commercial Chassis generators utilize an integrated circuit regulator mounted inside the generator. This regulator does not vary in voltage setting with age, consequently does not require checking or adjusting.

Two modes of failure can occur, no field feed resulting in undercharge, and no voltage control resulting in severe overcharge.

A 42 ampere generator is used on 693 series cars without air conditioning, and a 63 ampere generator with air conditioning. An 80 ampere generator is included on all cars equipped with the Trailer Towing package.

The limousine and commercial chassis use the 80 ampere generator as standard equipment. The optional heavy duty generator for commercial chassis only will be covered later in this section.

These generators illustrated in Fig. 6-47 and 6-48 feature a solid state regulator that is mounted inside the generator slip ring end frame. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage setting never needs adjusting, and no provision for adjustment is provided.

The generator rotor bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor,

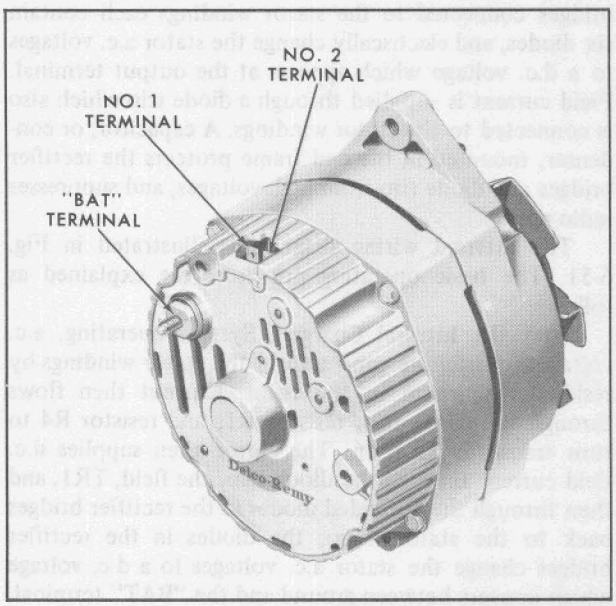


Fig. 6-47 693 Series Generator

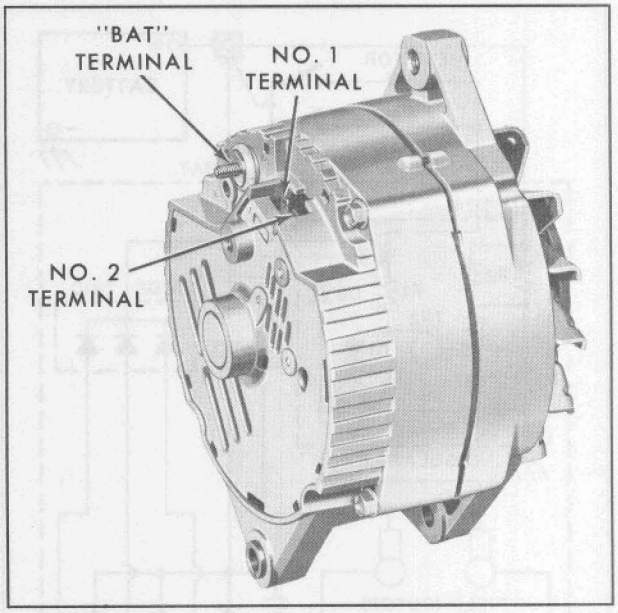


Fig. 6-48 697 and 698 Series Generator

and under normal conditions will provide long periods of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator a.c. voltages to a d.c. voltage which appears at the generator output terminal. Generator field current is supplied through a diode trio which also is connected to the stator windings. A capacitor, or condenser, mounted in the end frame protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

No periodic adjustments or maintenance of any kind are required on the entire generator assembly.

A wiring circuit diagram is illustrated in Fig. 6-49. The basic operating principles are explained as follows.

When the switch is closed, current from the battery flows through the indicator lamp and resistor to the generator No. 1 terminal, through resistor R1, diode D1, and the base-emitter of transistor TR1 to ground, and then back to the battery. This turns on transistor TR1, and current flows through the generator field coil and TR1 back to the battery. The resistor in parallel with the indicator lamp reduces total circuit resistance to provide higher field current for initial voltage build-up when the engine starts.

With the generator operating, a.c. voltages are generated in the stator winding, and the stator supplies d.c. field current through the diode trio, the field, TR1, and then through the grounded diodes in the rectifier bridge back to the stator. Also, the six diodes in the rectifier bridge change the stator a.c. voltages to a d.c. voltage which appears between ground and the generator "BAT" terminal. As generator speed increases, current is provided for charging the battery and operating electrical accessories. Also, with the generator operating, the same voltage appears at the "BAT" and No. 1 terminals, and the indicator lamp goes out to indicate the generator is producing voltage.

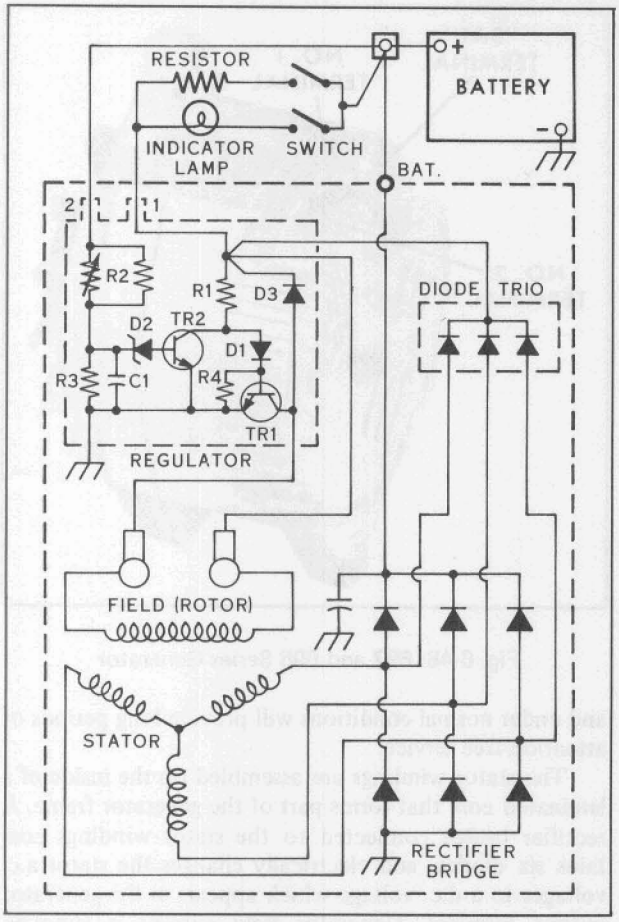


Fig. 6-49 Basic Charging Circuit (With Integral Regulator)

The No. 2 terminal on the generator is always connected to the battery but the discharge current is limited to a negligible value by the high resistances of R2 and R3. As the generator speed and voltage increase, the voltage between R2 and R3 increases to the point where zener diode D2 conducts. Transistor TR2 then turns on and TR1 turns off. With TR1 off, the field current and system voltage decrease, and D2 then blocks current flow, causing TR1 to turn back on. The field current and system voltage increase, and this cycle then repeats many times per second to limit the generator voltage to a preset value.

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D3 prevents high-induced-voltages in the field windings when TR1 turns off. Resistor R2 is a thermistor which causes the regulated voltage to vary with temperature, thus providing the optimum voltage for charging the battery.

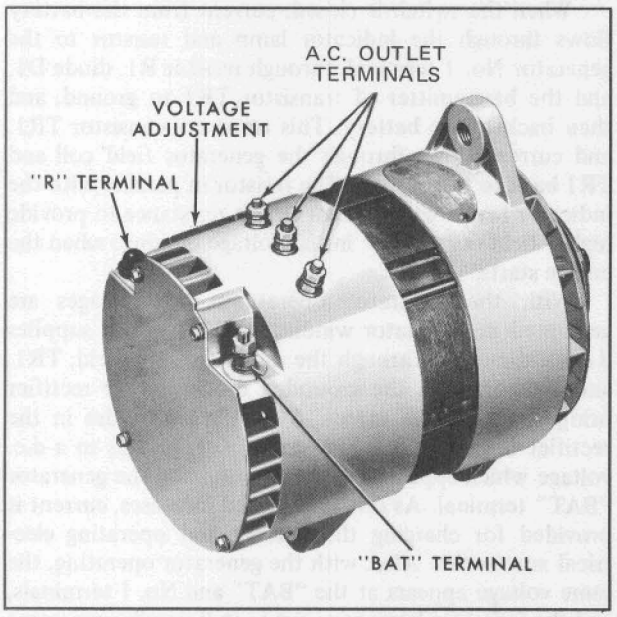


Fig. 6-50 Generator (With Heavy Duty Option)

Generator (With H.D. Generator)

The optional heavy duty integral charging system for the Commercial Chassis is illustrated in Figs. 6-50 through 6-51 and features a solid state regulator that is mounted inside the slip ring end frame. The regulator voltage setting can be adjusted externally by repositioning a voltage adjustment cap in the slip ring end frame. This feature is covered in detail in Fig. 6-44. Only one wire is needed to connect the Integral Charging System to the battery, along with an adequate ground return. To operate auxiliary equipment, three a.c. terminals are provided to which a transformer-rectifier combination may be connected for conversion to 110 volts d.c.

The rotor bearing in the slip ring end frame contains a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. The drive end frame bearing is sealed on both sides and is serviced by complete replacement. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long periods of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the frame. Rectifier bridges connected to the stator windings each contain six diodes, and electrically change the stator a.c. voltages to a d.c. voltage which appears at the output terminal. Field current is supplied through a diode trio which also is connected to the stator windings. A capacitor, or condenser, mounted in the end frame protects the rectifier bridges and diode trio from high voltages, and suppresses radio noise.

The internal wiring diagram is illustrated in Fig. 6-51. The basic operating principles are explained as follows.

With the Integral Charging System operating, a.c. voltages initially are generated in the stator windings by residual magnetism in the rotor. Current then flows through the diode trio, resistor R1, and resistor R4 to turn transistor TR1 on. The stator then supplies d.c. field current through the diode trio, the field, TR1, and then through the grounded diodes in the rectifier bridges back to the stator. Also, the diodes in the rectifier bridges change the stator a.c. voltages to a d.c. voltage which appears between ground and the "BAT" terminal. As speed increases, current is provided for charging the battery and operating electrical accessories.

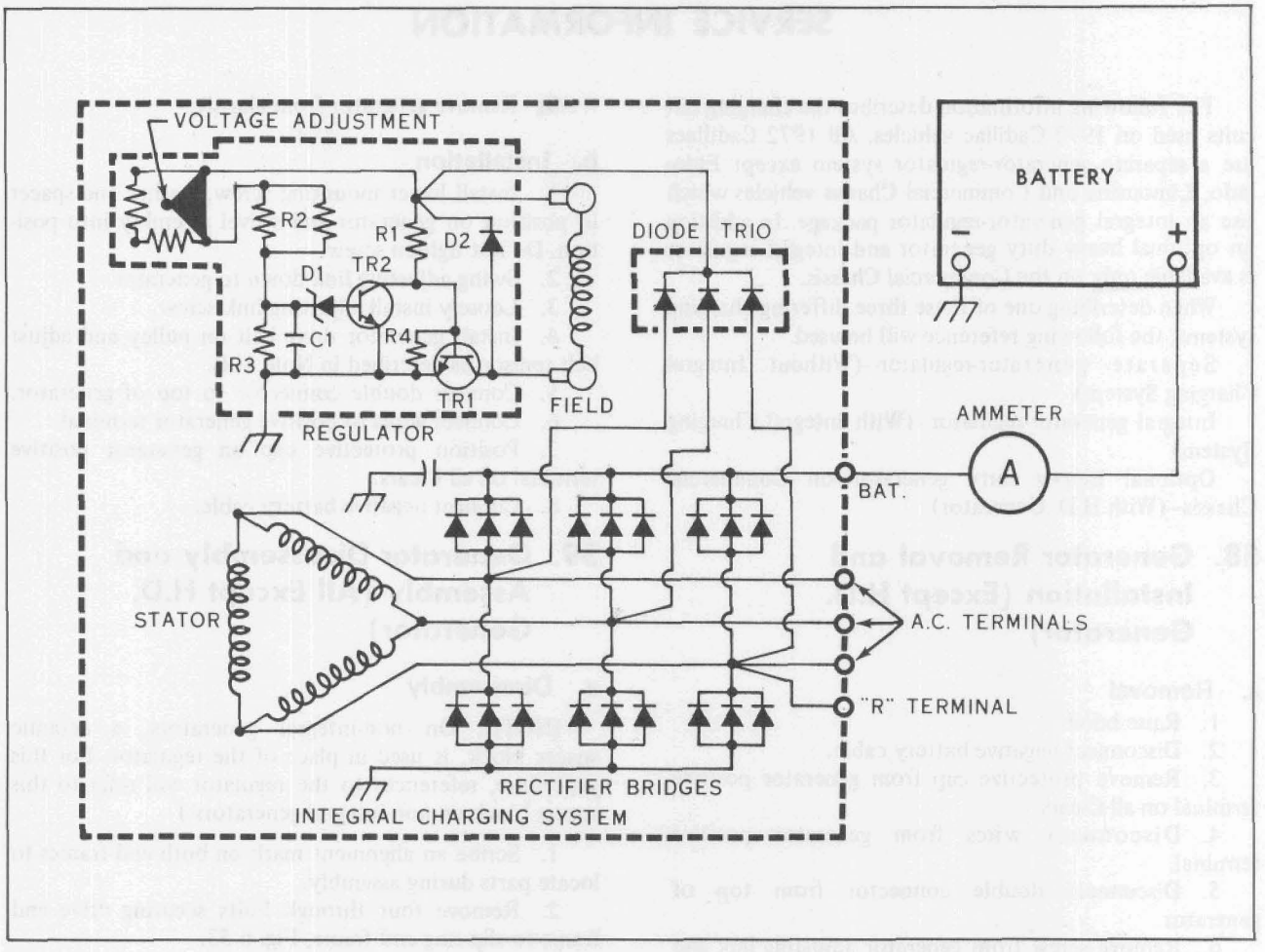


Fig. 6-51 Internal Wiring Diagram (With Heavy Duty Option)

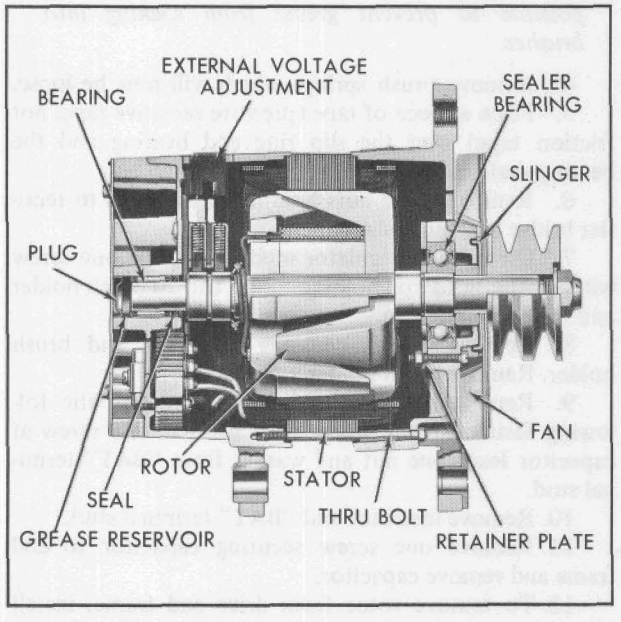


Fig. 6-52 Generator Cutaway View (With Heavy Duty Generator)

As the speed and voltage increase, the voltage between R2 and R3 increases to the value where zener diode D1 conducts. Transistor TR2 then turns on and TR1 turns off. With TR1 off, the field current and system voltage decrease, and D1 then blocks current flow causing TR1 to turn back on. The field current and system voltage increase, and this cycle then repeats many times per second to limit the voltage to the adjusted value.

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D2 prevents high-induced-voltages in the field windings when TR1 turns off.

SERVICE INFORMATION

The following information describes the charging circuits used on 1972 Cadillac vehicles. All 1972 Cadillacs use a separate generator-regulator system except Eldorado, Limousine and Commercial Chassis vehicles which use an integral generator-regulator package. In addition an optional heavy duty generator and integral regulator is available only on the Commercial Chassis.

When describing one of these three differing charging systems, the following reference will be used.

Separate generator-regulator–(Without Integral Charging System)

Integral generator-regulator–(With Integral Charging System)

Optional heavy duty generator on Commercial Chassis–(With H.D. Generator)

58. Generator Removal and Installation (Except H.D. Generator)

a. Removal

1. Raise hood.
2. Disconnect negative battery cable.
3. Remove protective cap from generator positive terminal on all C-cars.
4. Disconnect wires from generator positive terminal.
5. Disconnect double connector from top of generator.
6. Remove screw from generator adjusting link and raise adjusting link.
7. Loosen lower generator mounting screw and remove generator drive belt.
8. Remove lower generator mounting screw, spacer and washer by twisting generator towards fender for bolt clearance.

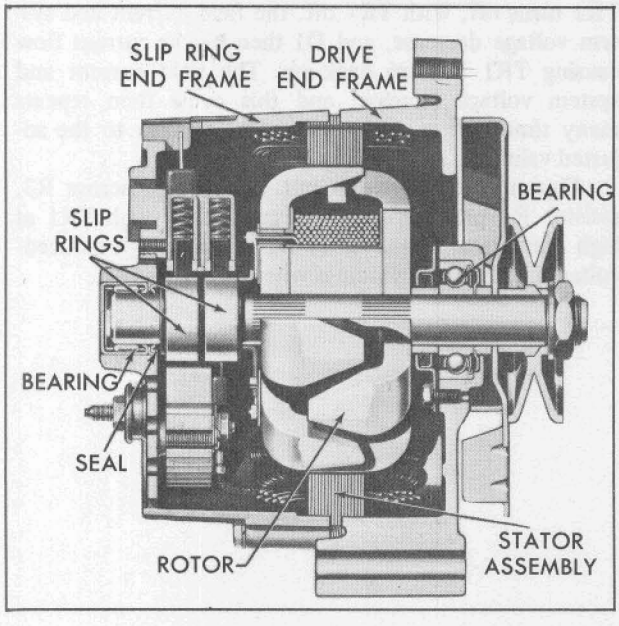


Fig. 6-53 Generator Cutaway View

9. Remove generator from chassis.

b. Installation

1. Install lower mounting screw, washer and spacer in position on generator and swivel assembly into position. Do not tighten screw.
2. Swing adjusting link down to generator.
3. Loosely install adjusting link screw.
4. Install generator drive belt on pulley and adjust belt tenison as described in Note 10B.
5. Connect double connector to top of generator.
6. Connect wires to positive generator terminal.
7. Position protective cap on generator positive terminal on all C-cars.
8. Connect negative battery cable.

59. Generator Disassembly and Assembly (All Except H.D. Generator)

a. Disassembly

(NOTE: On non-integral generators, a ceramic spacer block, is used in place of the regulator. For this procedure, references to the regulator will refer to this spacer block on non-integral generators.)

1. Scribe an alignment mark on both end frames to locate parts during assembly.
2. Remove four through bolts securing drive end frame to slip ring end frame, Fig. 6-53.
3. Separate drive end frame and rotor from slip ring end frame and stator.

CAUTION: Brushes should be cleaned as soon as possible to prevent grease from soaking into brushes.

4. Remove brush springs which will now be loose.
5. Place a piece of tape (pressure sensitive tape, not friction tape) over the slip ring end bearing and the bearing shaft on the rotor.
6. Remove three nuts holding stator leads to rectifier bridge and remove stator.
7. On integral regulator models, remove one screw with plastic insulator holding diode trio to brush holder and remove diode trio.
8. Remove screws securing regulator and brush holder. Remove brush holder and regulator.
9. Remove rectifier bridge by removing the following fasteners: one screw with washer; one screw at capacitor lead; one nut and washer from "BAT" terminal stud.
10. Remove insulator and "BAT" terminal stud.
11. Remove one screw securing capacitor to end frame and remove capacitor.
12. To remove rotor from drive end frame, install rotor in a vise and tighten only enough to permit removal of shaft nut.

CAUTION: Avoid excessive tightening as this may cause distortion of the rotor.

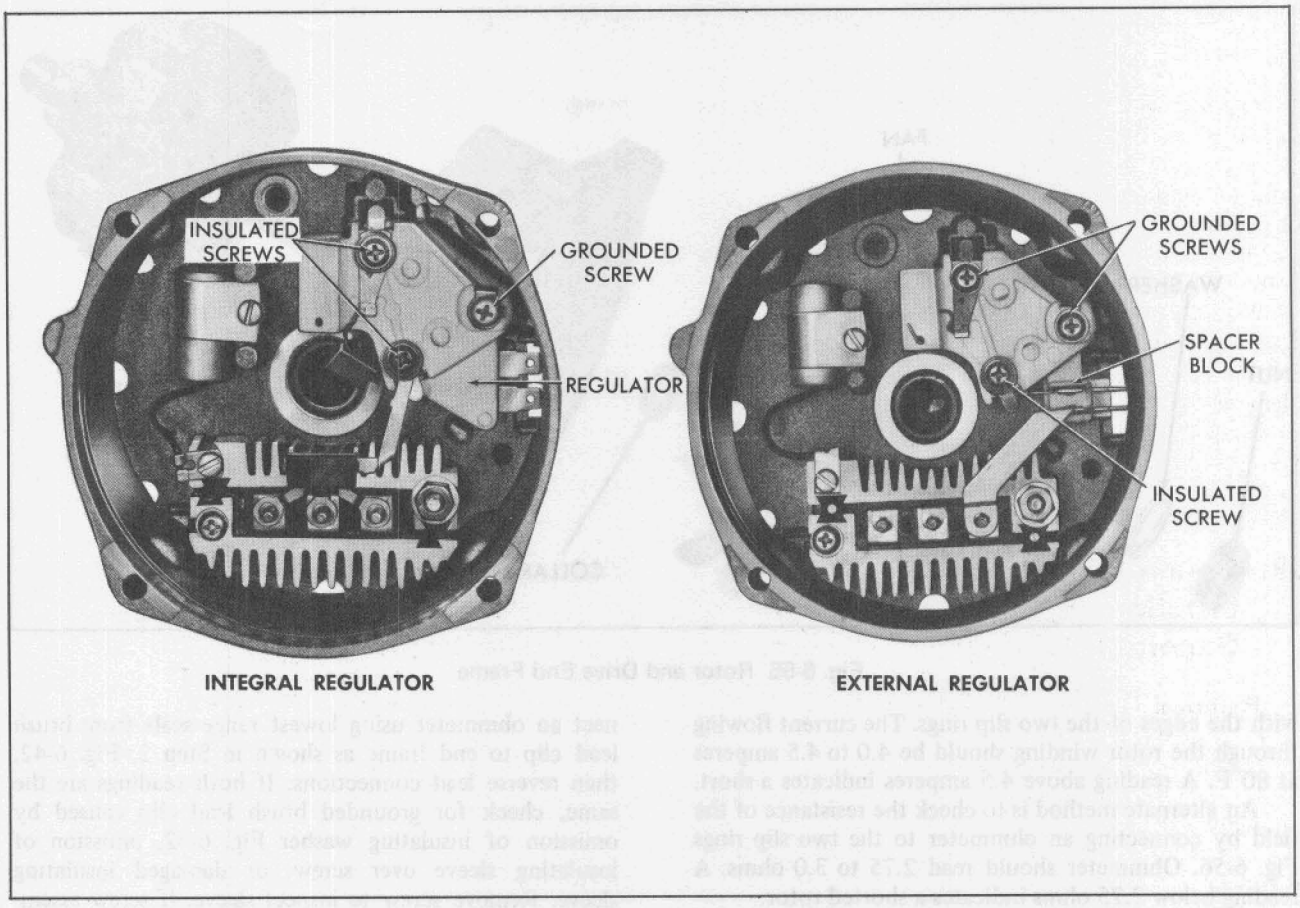


Fig. 6-54 Regulator Attaching Screw Location

13. Remove shaft nut, washer, pulley, fan and collar. Separate end frame from rotor.

b. Assembly

(NOTE: On non-integral generators, a ceramic spacer block, is used in place of the regulator. For this procedure, references to the regulator will refer to this spacer block on non-integral generators.)

1. Position "BAT" terminal stud in end frame with molded plastic insulator outside and fiber insulator inside.
2. Position rectifier bridge to end frame and secure with nut and washer at one end and screw with washer at opposite end.
3. Install capacitor and secure to end frame and heat sink with screws, Fig. 6-54.
4. Position regulator (or spacer block) in slip ring end frame. Position brush holder over regulator. Do not install mounting screws.
5. On integral regulator models position diode trio on rectifier bridge and secure to regulator with insulated screw, Fig. 6-54.
6. Secure regulator and brush holder to end frame with insulated and non-insulated screws as shown in Fig. 6-54.
7. Position stator to end frame with leads over rectifier bridge studs and secure with three nuts.
8. Install brush springs and brushes in brush holder and insert a straight wire or pin through hole in end frame and holes in bottom of brush holder. This will hold brushes until rotor is assembled into frame.
9. Install rotor in vise with drive end up. Tighten vise firm but not tight.

CAUTION: Avoid excessive tightening as this may cause distortion of the rotor.

10. Position end frame, collar, fan, pulley and washer over rotor shaft, Fig. 6-55, secure with nut.
11. Install rotor to slip ring end frame aligning scribe marks when installing. Remove brush holding wire.
12. Secure drive end frame to slip ring end frame with four through bolts.

60. Generator Inspection and Test (All Except H.D. Generator)

a. Rotor Field Winding Checks

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open Fig. 6-56.

The winding is checked for short circuits or excessive resistance by connecting a battery and ammeter in series

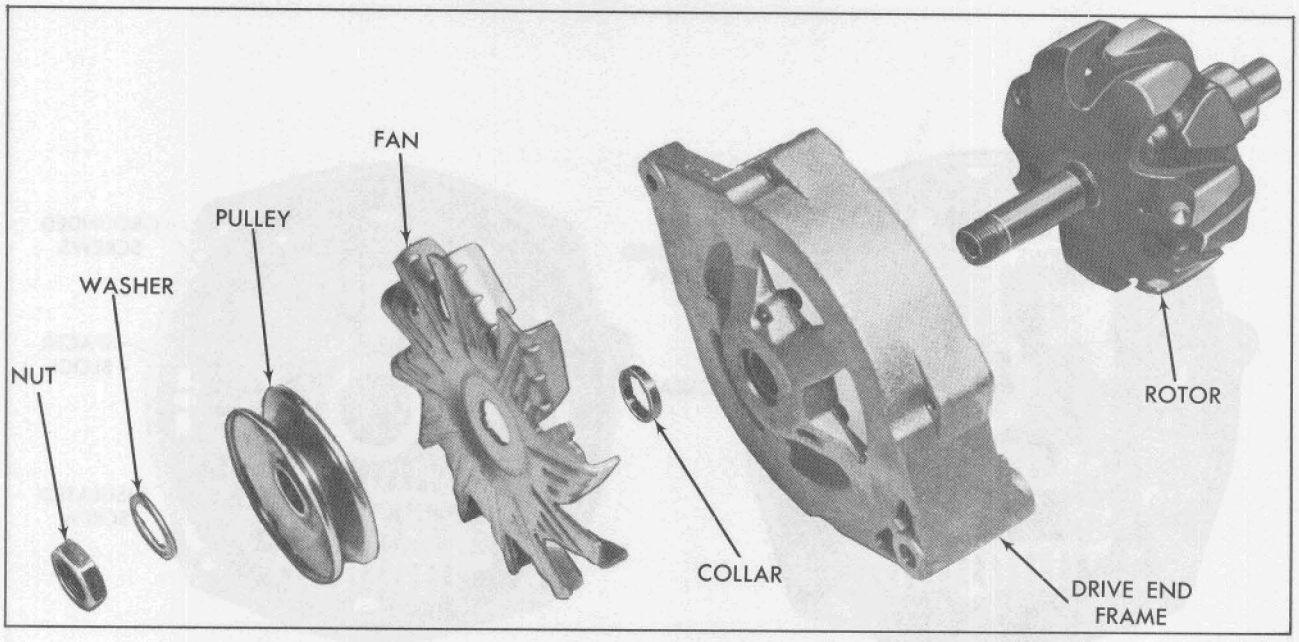


Fig. 6-55 Rotor and Drive End Frame

with the edges of the two slip rings. The current flowing through the rotor winding should be 4.0 to 4.5 amperes at 80°F. A reading above 4.5 amperes indicates a short.

An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings Fig. 6-56. Ohmmeter should read 2.75 to 3.0 ohms. A reading below 2.75 ohms indicates a shorted rotor.

Remember that the winding resistance and ammeter readings will vary slightly with winding temperature changes. If the rotor is not defective, but the generator fails to supply rated output, the defect is in the diode trio, rectifier bridge or stator.

b. Diode Trio Check (Integral Generators Only)

The diode trio is identified in Fig. 6-42. First, connect an ohmmeter using lowest range scale from brush lead clip to end frame as shown in Step 2, Fig. 6-42, then reverse lead connections. If both readings are the same, check for grounded brush lead clip caused by omission of insulating washer Fig. 6-42, omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If screw assembly is correct, and both ohmmeter readings are the same, replace regulator.

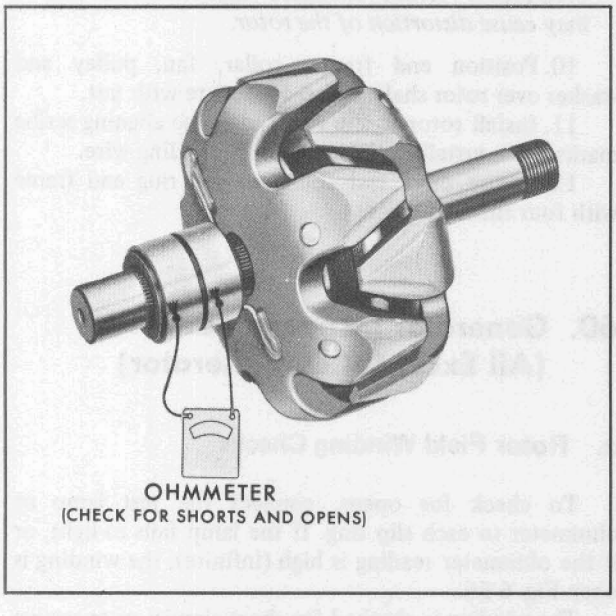


Fig. 6-56 Checking Rotor Winding

To check the diode trio, remove it from the end frame assembly by detaching the three nuts, the attaching screw, and removing the stator assembly. Note that the insulating washer on the screw is assembled over the top of the diode trio connector. Connect an ohmmeter having a 1½ volt cell, and using the lowest range scale, to the single connector and to one of the three connectors Fig. 6-57. Observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors.

(NOTE: Fig. 6-42 and 6-57 illustrate two diode trios differing in appearance. Either one of these diode trios may be used in these generators, and the two are completely interchangeable.)

c. Rectifier Bridge Check

Note that the rectifier bridge has a grounded heat sink and an insulated heat sink connected to the output terminal. Also, note the insulating washer located between the insulated heat sink and end frame Fig. 6-58.

To check the rectifier bridge, connect one lead of ohmmeter to the grounded heat sink and press down very firmly onto one of the flat metal connectors and not on threaded stud with other lead. Then reverse the lead connections to the grounded heat sink and press down very firmly onto the same flat metal connector,

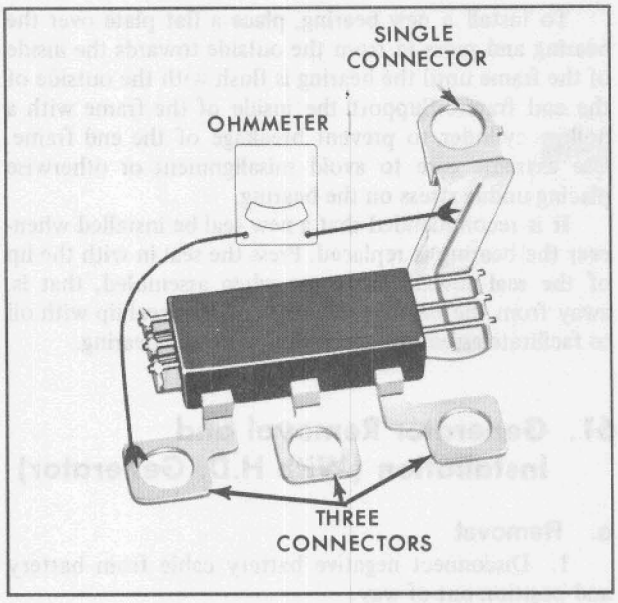


Fig. 6-57 Checking Diode Trio

and not on threaded stud Fig. 6-58. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two flat metal connectors and not on the threaded studs. This makes a total of six checks, with two readings taken for each check.

The ohmmeter check of the rectifier bridge, and of the diode trio as previously covered, is a valid and accurate check. Do not replace either unit unless at least one pair of readings is the same.

CAUTION: Do not use high voltage to check these units such as 110 volt test lamp.

To replace the rectifier bridge, remove the attaching screw and the "BAT" terminal screw, and disconnect the capacitor lead. Note the insulator between the insulated heat sink and end frame Fig. 6-58.

d. Stator Checks

The stator windings may be checked with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light, or if the meter reading is high when successively connected between each pair of stator leads, the windings are open Fig. 6-59.

A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated. Also, a shorted stator can cause the indicator lamp to be on with the engine at low speed.

e. Brush Holder and Regulator Replacement

After removing the three attaching nuts, the stator, and diode trio screw Fig. 6-58 the brush holder and

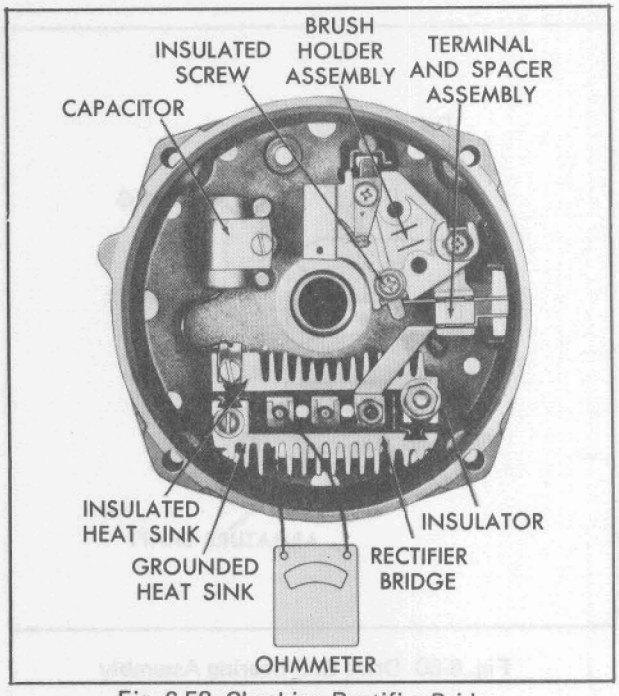


Fig. 6-58 Checking Rectifier Bridge

regulator may be replaced by removing the two remaining screws. Note the two insulators located over the top of the brush clips in Fig. 6-54, and that these two screws have special insulating sleeves over the screw body above the threads. The third mounting screw may or may not have an insulating sleeve. If not, this screw must not be interchanged with either one of the other two screws, as a ground may result, causing no output or uncontrolled generator output. Regulators may vary in appearance but are completely interchangeable in these generators.

f. Slip Ring Servicing

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the

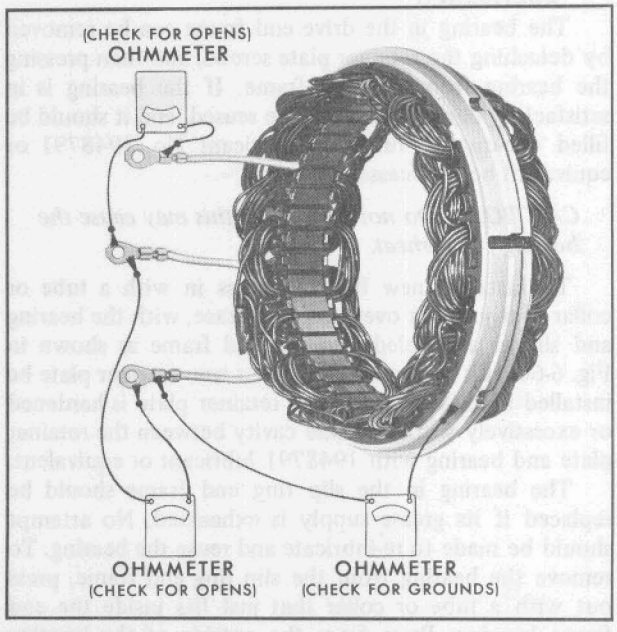


Fig. 6-59 Checking Stator Windings

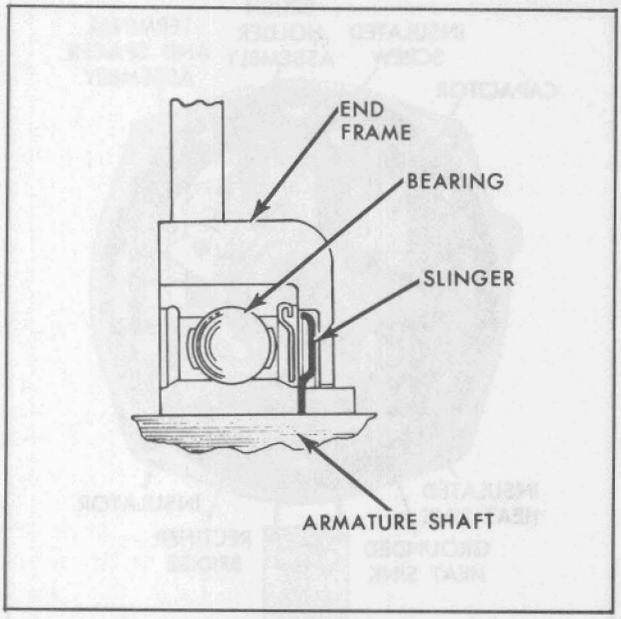


Fig. 6-60 Drive End Bearing Assembly

rotor, and hold the polishing cloth against the slip rings until they are clean.

CAUTION: The rotor must be rotated so that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

g. Bearing Replacement and Lubrication

The bearing in the drive end frame can be removed by detaching the retainer plate screws, and then pressing the bearing from the end frame. If the bearing is in satisfactory condition, it may be reused, and it should be filled one-quarter full with lubricant No. 1948791 or equivalent before reassembly.

CAUTION: Do not overfill, as this may cause the bearing to overheat.

To install a new bearing, press in with a tube or collar that just fits over the outer race, with the bearing and slinger assembled into the end frame as shown in Fig. 6-60. It is recommended that a new retainer plate be installed if the felt seal in the retainer plate is hardened or excessively worn. Fill the cavity between the retainer plate and bearing with 1948791 lubricant or equivalent.

The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to re-lubricate and reuse the bearing. To remove the bearing from the slip ring end frame, press out with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside.

To install a new bearing, place a flat plate over the bearing and press in from the outside towards the inside of the frame until the bearing is flush with the outside of the end frame. Support the inside of the frame with a hollow cylinder to prevent breakage of the end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on the bearing.

It is recommended that a new seal be installed whenever the bearing is replaced. Press the seal in with the lip of the seal toward the rotor when assembled, that is, away from the bearing. Lightly coat the seal lip with oil to facilitate assembly of the shaft into the bearing.

61. Generator Removal and Installation (With H.D. Generator)

a. Removal

1. Disconnect negative battery cable from battery and position out of way.
2. Disconnect all wiring connections from generator and position out of way.
3. Loosen belt tensioning pulley bolts to relieve belt tension and remove belt.
4. Remove two nuts and lock washers from lower mouting bolts, at generator, leaving bolts in place.
5. Remove bolt and lock washer from upper mounting at generator and remove generator by sliding rearward off lower mounting bolts.

b. Installation

1. Position generator to lower mounting bracket and install lower mounting bolts.
2. Install bolt and lock washer securing generator to upper mounting bracket and tighten bolt to 60 ft. lbs.
3. Install lock washers and nuts on lower mounting bolts and tighten nuts to 60 ft. lbs.
4. Position belt around generator and belt tensioning pulley and adjust belt tension as described in Note 10b. Tighten tensioning pulley bolts to 19 foot-pounds.
5. Position wiring harness and connect to required generator terminals.
6. Position negative battery cable and connect to battery.

62. Generator Disassembly and Assembly (With H.D. Generator)

a. Disassembly

1. Remove cover plate from slip ring end frame.
2. Hold rotor shaft with allen wrench while removing shaft nut. Remove washer, pulley, fan and slinger.
3. Remove four through bolts securing drive end frame to slip ring end frame and separate slip ring end frame and stator from drive end frame and rotor.

CAUTION: Brushes should be cleaned as soon as possible to prevent grease from soaking into brushes.

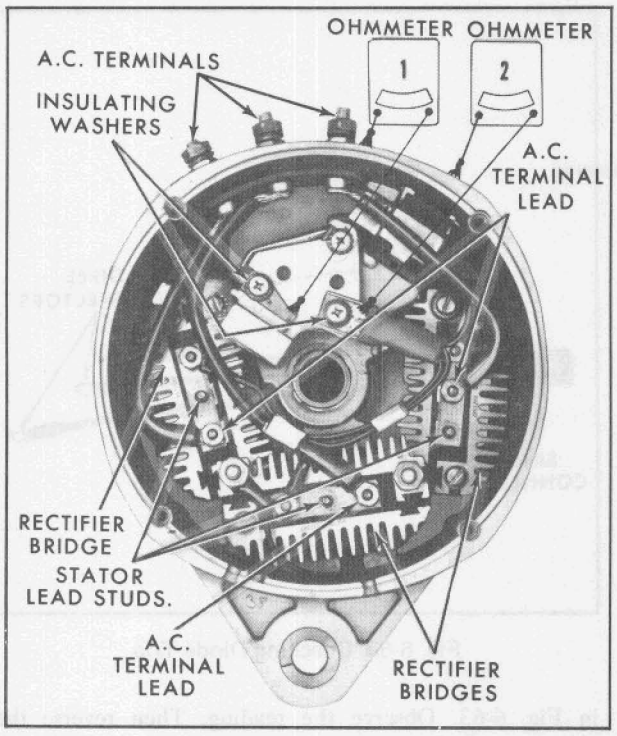


Fig. 6-61 Slip Ring End Frame (With Heavy Duty Generator)

4. Separate stator from slip ring end frame by removing the nuts and washers from the three stator lead studs, Fig. 6-61.

5. Place tape over bearing and shaft to protect from dirt. Use pressure sensitive tape and not friction tape which would leave a gummy deposit.

6. Remove two remaining nuts and washers from each rectifier bridge.

7. Remove the following from the A.C. terminal studs: nut, lockwasher, flat washer insulating washer and insulating collar.

8. Remove screw with flat washer and insulator securing diode trio at brush holder and remove diode trio, A.C. leads and inner insulator.

9. Remove connector strap from each rectifier bridge.

10. Remove two nuts with internal tooth lockwashers and flat washers securing bottom rectified bridge and remove two terminal studs.

11. Remove one screw with lock and flat washers securing bottom rectifier bridge to end frame and remove rectifier bridge.

12. To remove bridge nearest voltage adjuster, remove two screws with lock and flat washers.

13. To remove remaining rectifier bridge it is necessary to loosen the nut at the "BAT" terminal. Remove one screw with external tooth lockwasher securing "BAT" terminal lead to bridge.

14. Remove one additional screw securing bridge to end frame and remove bridge.

15. Remove two remaining screws securing brush holder and remove brush holder.

16. Remove voltage adjuster cap making note of cap position for assembly.

17. Remove one screw securing voltage regulator bracket to end frame and remove bracket and regulator.

18. Capacitor and "R" terminal lead may now be removed if desired.

19. To remove rotor from drive end frame, remove four screws from around drive end bearing and tap rotor out of housing with a soft faced hammer.

20. To remove bearings refer to Note 63i.

b. Assembly

1. Install capacitor and "R" terminal lead if removed.

2. Position voltage regulator and adjuster to end frame. Position bracket over adjuster and secure with one screw and external tooth lockwahser.

3. Install voltage adjustment cap in same position as removed.

4. Of the three rectifier bridges, two are identical and one has an insulating sleeve at one end. Select one of the two identical ones and position under the "BAT" lead. Secure to end frame using one screw with lock and flat washers. Secure "BAT" lead to bridge using one screw with external tooth lockwasher.

5. Tighten "BAT" terminal nut.

6. Install bridge with insulator at opposite side of end frame. Secure using two screws with lock and flat washers.

7. Position remaining rectifier bridge in end frame. Install two terminal bolts with internal tooth lockwashers. Use a flat washer at end with insulated bridge and capacitor lead at opposite end. Install but do not tighten nuts.

8. Install one screw with lock and flat washers securing bridge to end frame and tighten screw. Tighten two nuts installed in Step 7.

9. Install connector strap to each bridge, Fig. 6-62.

10. Install insulator at inside of end frame for A.C. terminal studs and position diode trio and A.C. terminal leads as shown in Fig. 6-62.

11. Install insulating sleeve, insulating washer, flat washer, lockwasher and nut to each A.C. terminal. Tighten nuts.

12. Position diode trio and A.C. leads at each bridge as shown in Fig. 6-62. Secure each lead with nut and flat washer.

13. Install brush holder over voltage regulator and secure with three screws. Two screws nearest bearing have insulating washers. All screws have flat washers, Fig. 6-62.

14. Install brush springs and brushes. Hold brushes. Hold brushes in position with paper clip through holder and end frame.

15. Position stator to end frame with notches in stator aligned with holes for through bolts.

16. Install stator leads to bridges at remaining open terminals. Secure with nuts and flat washers.

17. If removed, install drive end frame to rotor. Align weld nut plate and secure with four screws.

18. Remove tape from slip ring end bearing and rotor shaft. Make sure the shaft is perfectly clean after removing the tape.

19. Install rotor and drive end frame to stator and

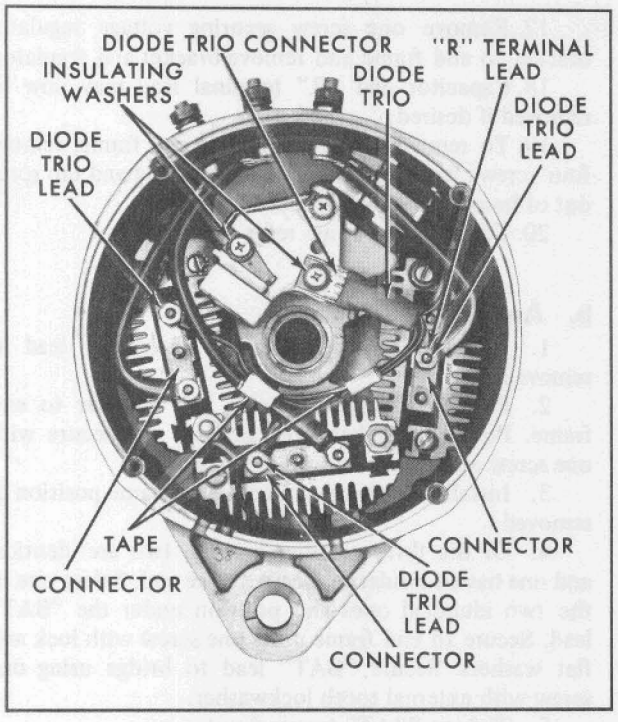


Fig. 6-62 Slip Ring End Frame Components (With Heavy Duty Generator)

slip ring end frame after aligning mounting lugs and through bolt holes. Secure with four through bolts.

20. Remove brush holding pin and install cover plate to slip ring end frame. Secure with four screws.

21. Assemble slinger, fan, pulley, washer and nut on rotor shaft. Hold rotor shaft with an allen wrench and tighten nut to 75 foot-pounds.

63. Generator Inspection and Test (With H.D. Generator)

a. Ohmmeter Checks

1. Connect ohmmeter having a 1½ volt cell using lowest range scale from brush lead clip to end frame as shown in Step 1, Fig. 6-61, then reverse lead connections.

2. If both readings are zero, either the brush lead clip is grounded or regulator is defective.

3. A grounded brush lead clip can result from omission of insulating washer Fig. 6-61, omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If satisfactory, replace regulator as described in Part h of this Note.

4. Repeat Steps 1, 2 and 3 above, except connect ohmmeter as shown in Part 2, Fig. 6-61.

b. Diode Trio Check

The diode trio is identified in Fig. 6-62. To check the diode trio, remove it from the end frame assembly by detaching the nuts and attaching screw. Note that the insulating washer on the screw is assembled over the top of the diode trio connector. Connect an ohmmeter having a 1½ volt cell, and using the lowest range scale, to the single connector and to one of the three connectors

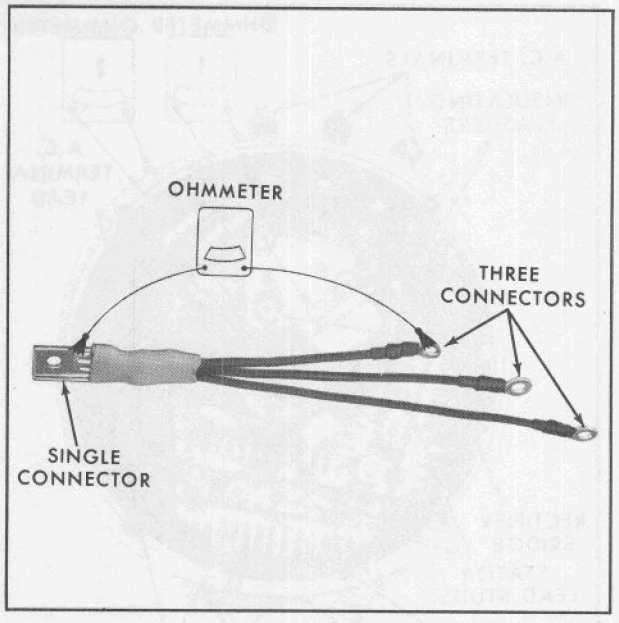


Fig. 6-63 Checking Diode Trio

in Fig. 6-63. Observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors.

(NOTE: Diode trios differing in appearance may be specified for use in the same integral Charging System, and the two are completely interchangeable.)

c. Rectifier Bridge Check

Note that each rectifier bridge has a grounded heat sink and an insulated heat sink. The insulated heat sinks are connected together, and electrically are connected to the output or "BAT" terminal. Also, note the stack-up of parts in Fig. 6-64.

To check the rectifier bridge, connect one lead of ohmmeter to a heat sink and press down very firmly onto one of the flat metal connectors and not on threaded stud with other lead. Then reverse the lead connections to the same heat sink and press down very firmly onto the same flat metal connector, and not on threaded stud Fig. 6-64. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two flat metal connectors and not on the threaded studs. This makes a total of six checks, with two readings taken for each check. Check the other two rectifier bridges in the same manner.

The ohmmeter check of the rectifier bridge, and of the diode trio as previously covered, is a valid and accurate check. Do not replace either unit unless at least one pair of readings is the same.

CAUTION: Do not use high voltage to check these units such as a 110-volt test lamp.

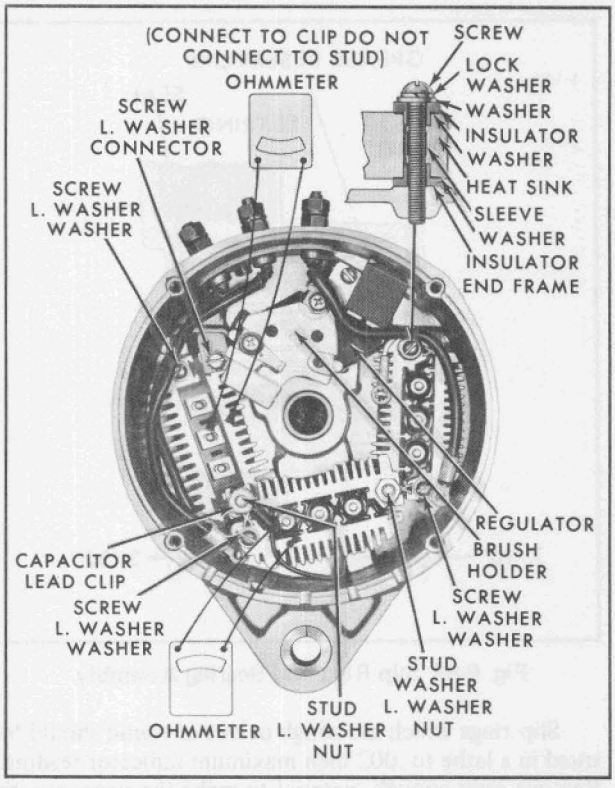


Fig. 6-64 Slip Ring End Frame Parts Position (With Heavy Duty Generator)

d. Rotor Field Winding Checks

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open Fig. 6-65.

The winding is checked for short circuits or excessive resistance by connecting a battery and ammeter in series with the edges of the two slip rings. The current flowing through the rotor winding should be 4.0 to 4.5 amperes at 80°F. A reading above 4.5 amperes indicates a short.

If the winding is shorted, replace the rotor, and the regulator as described in part h of this note.

(NOTE: Regulator replacement may have been indicated in Part b of this note.)

An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings Fig. 6-65. Ohmmeter should read 2.75 to 3.0 ohms. A reading below 2.75 ohms indicates a shorted rotor.

Remember that the winding resistance and ammeter reading will vary slightly with winding temperature changes.

e. Stator Checks

The stator windings may be checked for grounds with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to a clean metal part of the frame, the windings are grounded Fig. 6-66. The delta windings cannot be checked for opens or for short circuits without laboratory test equipment. However, if all other

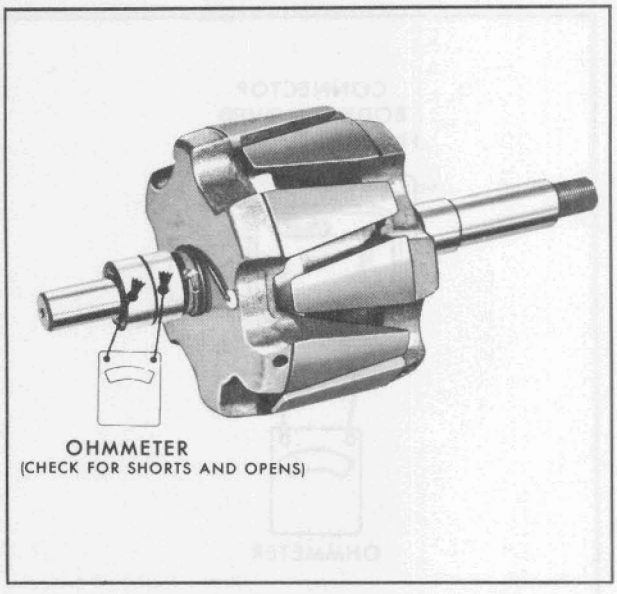


Fig. 6-65 Checking Rotor (Heavy Duty Generator)

electrical checks are normal and the generator fails to supply rated output, but will supply at least 10 amperes output, shorted stator windings are indicated.

f. Regulator Check

Since the regulator is completely enclosed, there is no practical way to check this unit with a test instrument. If none of the previous checks show any defects, and an overcharged condition was present, remove the connector body from the regulator and check with an ohmmeter using the middle range scale as shown in Fig. 6-67. Connect the ohmmeter to each adjacent pair of terminals, making four checks in all. If any one check is infinite, replace the connector body. The connector

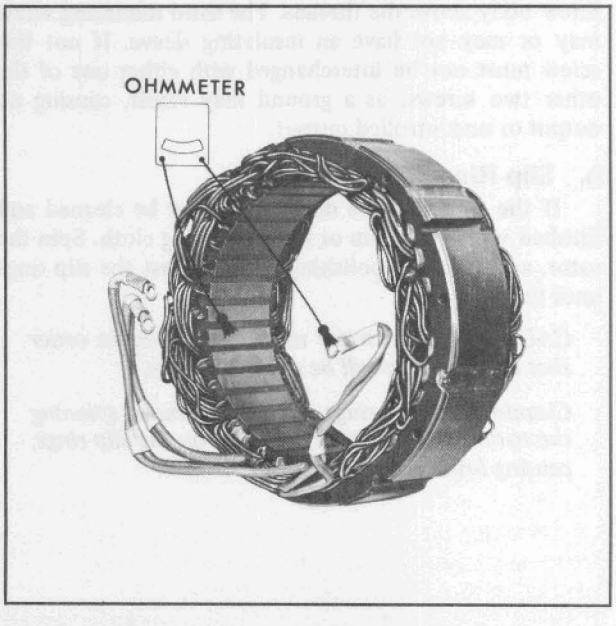


Fig. 6-66 Checking Stator (Heavy Duty Generator)

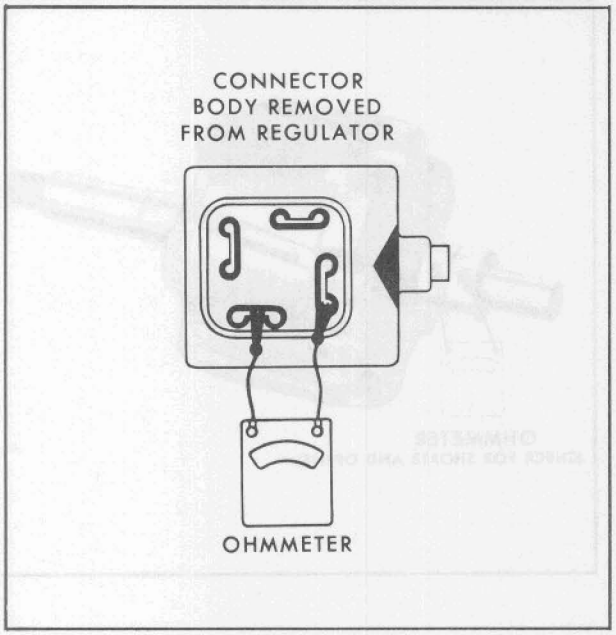


Fig. 6-67 Checking Connector Body

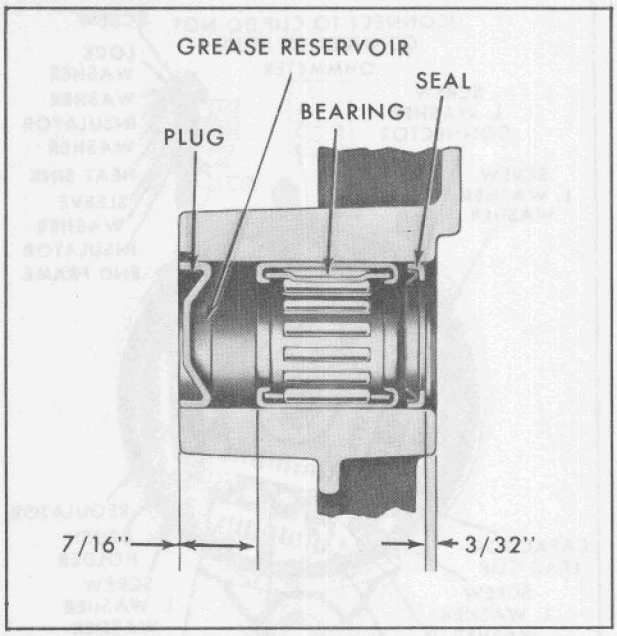


Fig. 6-68 Slip Ring End Bearing Assembly

body need not be checked for an undercharged condition.

If all of the previous checks are satisfactory, replace the regulator provided that in the previous performance checks:

1. The maximum ampere output was less than 10 amperes, or
2. The system voltage was over 15 volts.

g. Brush Holder and Regulator Replacement

After removing the stator and diode trio, the brush holder and regulator may be replaced by removing the two remaining screws. Note the two insulators located over the top of the brush clips in Fig. 6-54, and that these two screws have special insulating sleeves over the screw body above the threads. The third mounting screw may or may not have an insulating sleeve. If not this screw must not be interchanged with either one of the other two screws, as a ground may result, causing no output or uncontrolled output.

h. Slip Ring Servicing

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor, and hold the polishing cloth against the slip rings until they are clean.

CAUTION: The rotor must be rotated in order that the slip rings will be cleaned evenly.

Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

i. Bearing Replacement and Lubrication

The drive end frame bearing is sealed on both sides, and cannot be lubricated. To replace the bearing, pull off of rotor shaft using Puller J-8433. Use a tube or collar that just fits over the inner race to press the new bearing into the end frame.

The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to relubricate and reuse the bearing. To remove the bearing from the slip ring end frame, press out with a tube or collar that just fits inside the end frame housing.

To install a new bearing, use the tube or collar to press the bearing in from the outside of the housing towards the inside to the dimension shown in Fig. 6-68. Fill the plug with No. 1948791 lubricant or equivalent so that when pressed in flush with the end frame the grease reservoir will be half filled. Insure that some of the lubricant will be contacting the bearing when the plug is assembled. Use a new seal, and press in to the dimension shown in Fig. 6-68. Coat the seal lip with the lubricant to facilitate assembly of the rotor shaft into the bearing. Note that the lip of the seal is toward the bearing.

SPECIFICATIONS

BATTERY	
Except 693	R 71 S
693*	R 91 S
Capacity*	74 AMP Hours
Full Charge Specific Gravity @ 80	1.250 to 1.280
Voltage	12 Volts
Plates Per Cell	15
Cables	1/0 Gage
Terminal Grounded	Negative
STARTER MOTOR	
Brush Springs Tension	35 OZ
No Load Specifications	
Voltage	9 Volts
Amperage	65-95 AMPS
Speed	7,000-10,500 RPM
Cranking Power at 0°F	3,600 Watts
SOLENOID	
Amperage Draw at 10 Volts	
Hold-In Winding	14.5-16.5 AMPS
Both Windings	41-47 AMPS
GENERATOR	
Rated Output (At 14 Volts):	
W/O Air Conditioning	42 AMPS
With Air Conditioning	63 AMPS
697 & 698 W/O H.D. Generator**	80 AMPS
697 & 698 With H.D. Generator	145 AMPS
Field Current Draw (At 12 Volts and 80°F):	
W/O Air Conditioning	2.2 to 2.6 AMPS
With Air Conditioning	2.8 to 3.2 AMPS
With Integral Regulator	4.0 to 4.5 AMPS
Pulley Ratio:	
All	3.214 to 1
697 & 698 W/O H.D. Generator**	3.067 to 1
697 & 698 With H.D. Generator	2.275 to 1

REGULATOR (without integral charging system)	
Normal Operating Range (At 125°F)	13.5 to 14.4 Volts
Lower Contact Point setting (Lower than upper contact point setting)	.1 to .3 Volts
DISTRIBUTOR	
Initial Timing	8°BTDC
Rotation	Clockwise
Dwell Angle	
Range	28° - 32°
Set to	30°
Capacitor	.18 - .23 -MFD
Firing Order	1, 5, 6, 3, 4, 2, 7, 8
Centrifugal Advance	
Start	0°-2° @ 500 RPM
Maximum	11°-13° @ 2000 RPM
Vacuum Advance	
Start	8.0"-10.0"
Full	13.0"
Maximum Advance	12.60°
IGNITION COIL	
Amperage Draw (Engine Running)	1.25 AMPS
Primary Resistance	1.77-2.01 OHMS
Secondary Resistance	3,000-20,000 OHMS
Wiring Harness Primary Resistance (@80°F)	1.3-1.35 OHMS
SPARK PLUGS	
Type (AC Number)	R 46 N
Gap	.035 In.
Thread	14 MM
Torque	25 Foot-Pound

*A 76 AMP hour battery, R89W, is used for service replacement on 693 only.

**Also included with Trailer Towing Package.

TORQUE SPECIFICATIONS

Material No.	Application	Size	Torque
260M	Battery Cable to Battery Screw - 693	3/8–16	70 In. Lbs.
260M	Battery Hold Down Screw	5/16–24	6 Ft. Lbs.
260M	Battery Ground Strap to Frame Screw	Self Tapping	22 Ft. Lbs.
286M	Distributor Clamp Nut	5/16–24	18 Ft. Lbs.
260M	Generator Adjusting Link to Generator Screw	5/16–18	10 Ft. Lbs.
260M	Generator Support Bracket Screw	3/8–16	17 Ft. Lbs.
1112	Generator Support Bracket Nut	3/8–24	17 Ft. Lbs.
286M	Generator Terminal Nuts	1/4–20	26 In. Lbs.
–	Spark Plugs (Type R-46-N)	14 mm	25 Ft. Lbs.
280M	Starter Motor to Engine Block	7/16–14	46 Ft. Lbs.
Special	Starter Motor Brace Mounting Screw	5/16–18	12 Ft. Lbs.
Special	Starter Motor Brace Mounting Nut	1/4–20	6 Ft. Lbs.

NOTE: Refer to back of manual, page 16-1 for bolt and nut markings and steel classification.

SPECIAL TOOLS

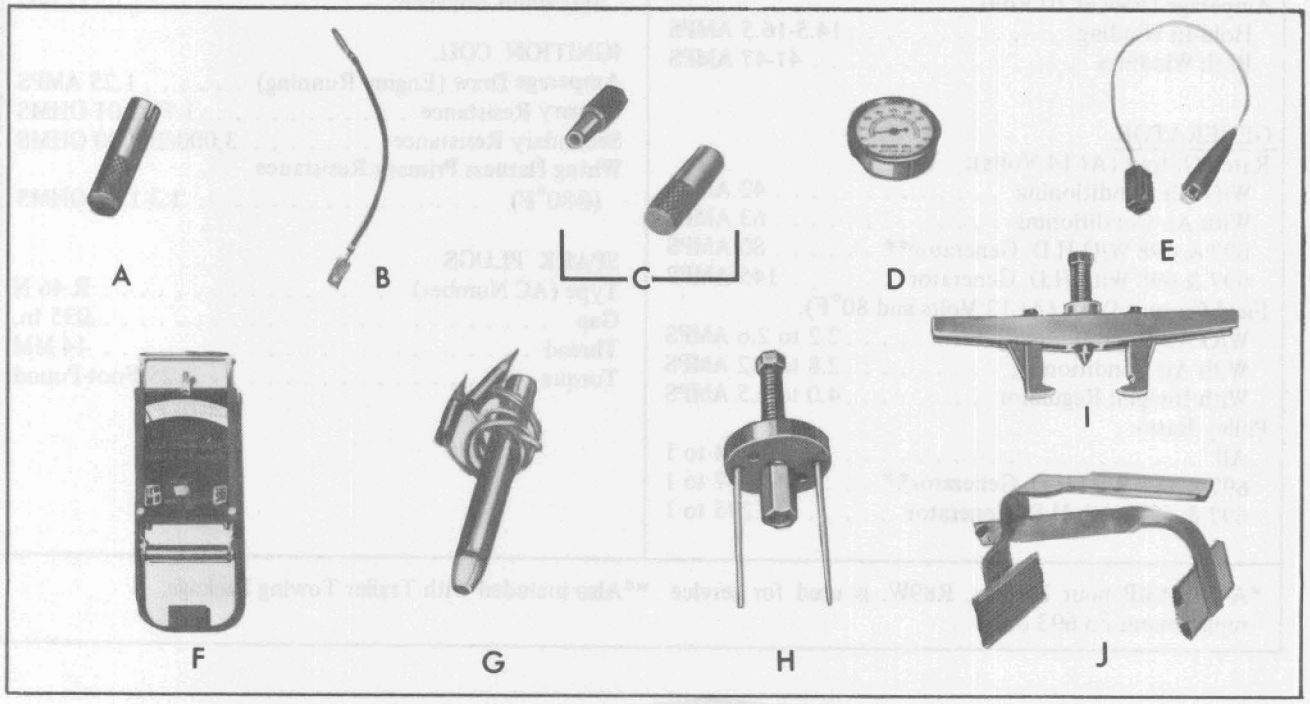


Fig. 6-69 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-9600-2	Diode Installer	F	J-23600	Belt Tension Gage
B	J-9782-1	Regulator Adapter Jumper	G	J-21008	Diode Tester
C	J-9717	Diode Remover Set	H	J-1859-02	Puller
D	J-8529	Voltage Regulator Temperature Gage	I	J-8433	Puller
E	J-21053	Generator Field Adapter	J	J-23686	Battery Lifting Tool (693)

THEORY OF OPERATION

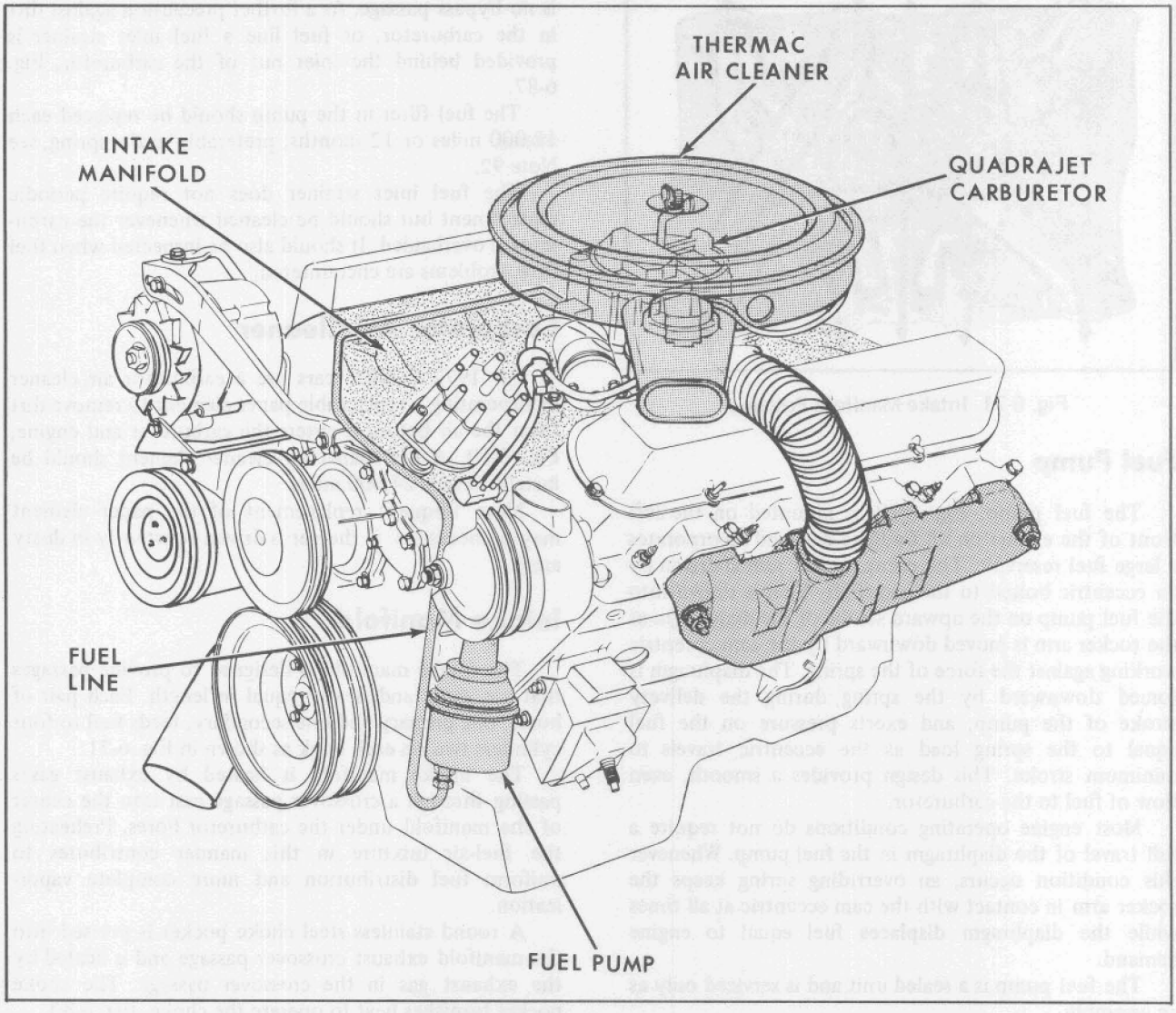


Fig. 6-70 Fuel System Components

The 1972 Cadillac engine fuel system, Fig. 6-70, covered in this section includes fuel pump with integral filter, fuel line, carburetor and intake manifold. Covered in this section are related components of these assemblies.

Fuel Requirements

For 1972, all Cadillac engines have been designed to operate efficiently, and with lower exhaust emissions, on low lead gasolines. If low lead gasoline is not available, any leaded regular grade gasoline with a Research Octane Number of 91 or higher may be used. Since the anti-knock quality of all gasolines is not the same, and factors such as terrain and air temperature affect operating efficiency, some knocking may result under unusual circumstances even though the proper grade of fuel is used.

On cars to be used in foreign countries, there is a possibility that the best available fuels are so low in anti-knock quality that it may be necessary to lower the octane requirement of the engine. If persistent knocking is encountered with the best fuel available, it may be necessary to retard spark timing. Engine fuel requirements are reduced by approximately one octane number (Motor Method) for each 2-1/2 degrees that spark timing is retarded from the normal 8 degree setting. Do not retard beyond top dead center.

Do not "power time" the engine, as variations in fuels, altitude and weather conditions will affect octane requirements. Never advance the spark beyond 8° B.T.D.C.

Storage Precautions

When a car is to be put in storage for 30 days or longer, it is best to drain all gasoline from the fuel system, including carburetor, fuel filter, fuel pump, lines and tank. This assures freedom from gum deposits that would be formed by evaporation of the fuel. See Section 0, Page 0-4 for further precautions.

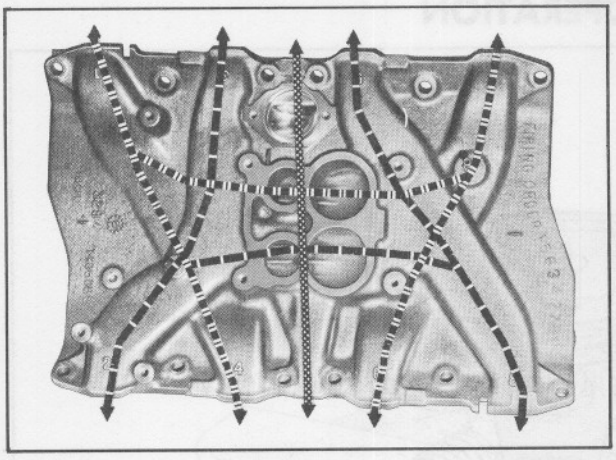


Fig. 6-71 Intake Manifold Passages

Fuel Pump

The fuel pump, Fig. 6-70, is mounted on the left front of the engine on all Cadillac cars and incorporates a large fuel reservoir. The pump rocker arm is driven by an eccentric bolted to the camshaft, Fuel is drawn into the fuel pump on the upward stroke of the diaphragm as the rocker arm is moved downward by the cam eccentric working against the force of the spring. The diaphragm is forced downward by the spring during the delivery stroke of the pump, and exerts pressure on the fuel equal to the spring load as the eccentric travels to minimum stroke. This design provides a smooth, even flow of fuel to the carburetor.

Most engine operating conditions do not require a full travel of the diaphragm in the fuel pump. Whenever this condition occurs, an overriding spring keeps the rocker arm in contact with the cam eccentric at all times while the diaphragm displaces fuel equal to engine demand.

The fuel pump is a sealed unit and is serviced only as an assembly.

Air conditioner equipped cars use a fuel pump with a bypass passage that continually returns part of the fuel to the fuel tank. This bypass also returns fuel vapors that may form in the lines or pump under high operating temperatures.

Fuel Filter

The fuel filter is an integral component of the fuel pump, Fig. 6-70, mounted inside the pump at the outlet fitting. It filters out dirt particles in excess of approximately .002 inch in diameter. Should the fuel filter become clogged with dirt, fuel flow will stop since there is no bypass passage. As a further precaution against dirt in the carburetor, or fuel line a fuel inlet strainer is provided behind the inlet nut of the carburetor, Fig. 6-87.

The fuel filter in the pump should be replaced each 12,000 miles or 12 months, preferably in the spring, see Note 92.

The fuel inlet strainer does not require periodic replacement but should be cleaned whenever the carburetor is overhauled. It should also be inspected when fuel flow problems are encountered.

Carburetor Air Cleaner

All 1972 Cadillac cars use a carburetor air cleaner incorporating a replaceable paper element to remove dirt from the air before it enters the carburetor and engine, Fig. 0-10. A new paper air cleaner element should be installed every 24,000 miles.

More frequent replacement of the paper element may be necessary if the car is driven constantly in dusty areas.

Intake Manifold

The intake manifold is designed to provide passages that are short and nearly equal in length. Each pair of bores, one primary and one secondary, feeds fuel to four cylinders two on each bank as shown in Fig. 6-71.

The intake manifold is heated by exhaust gases passing through a crossover passage cast into the center of the manifold under the carburetor bores. Preheating the fuel-air mixture in this manner contributes to uniform fuel distribution and more complete vaporization.

A round stainless steel choke pocket is pressed into the manifold exhaust crossover passage and is heated by the exhaust gas in the crossover passage. The choke pocket furnishes heat to operate the choke, Fig. 6-80.

Transmission Downshift Switch

All cars utilize a rotary transmission downshift switch that is activated at 60° throttle opening by the throttle adapter plate. This switch controls the detent downshift of the transmission through an electrical circuit that energizes the transmission detent solenoid.

The switch is located at the left of the carburetor and secured by two screws to a support attached to the intake manifold. Adjustment of the switch is covered in Section 7, Note 5c.

GENERAL DESCRIPTION
CADILLAC QUADRAJET CARBURETOR

(NOTE: For early 1972 production cars refer to the 1971 Shop Manual.)

The four-barrel Quadrajet carburetor, Fig. 6-72, used on all 1972 Cadillac cars has two stages of operation. The primary (fuel inlet) side has small bores with a triple venturi equipped with plain tube nozzles. Its metering principles are similar to those of other carburetors using the venturi principle. The triple venturi stack up, plus the smaller primary bores, give an excellent fuel control in the idle and economy ranges of operation. Fuel

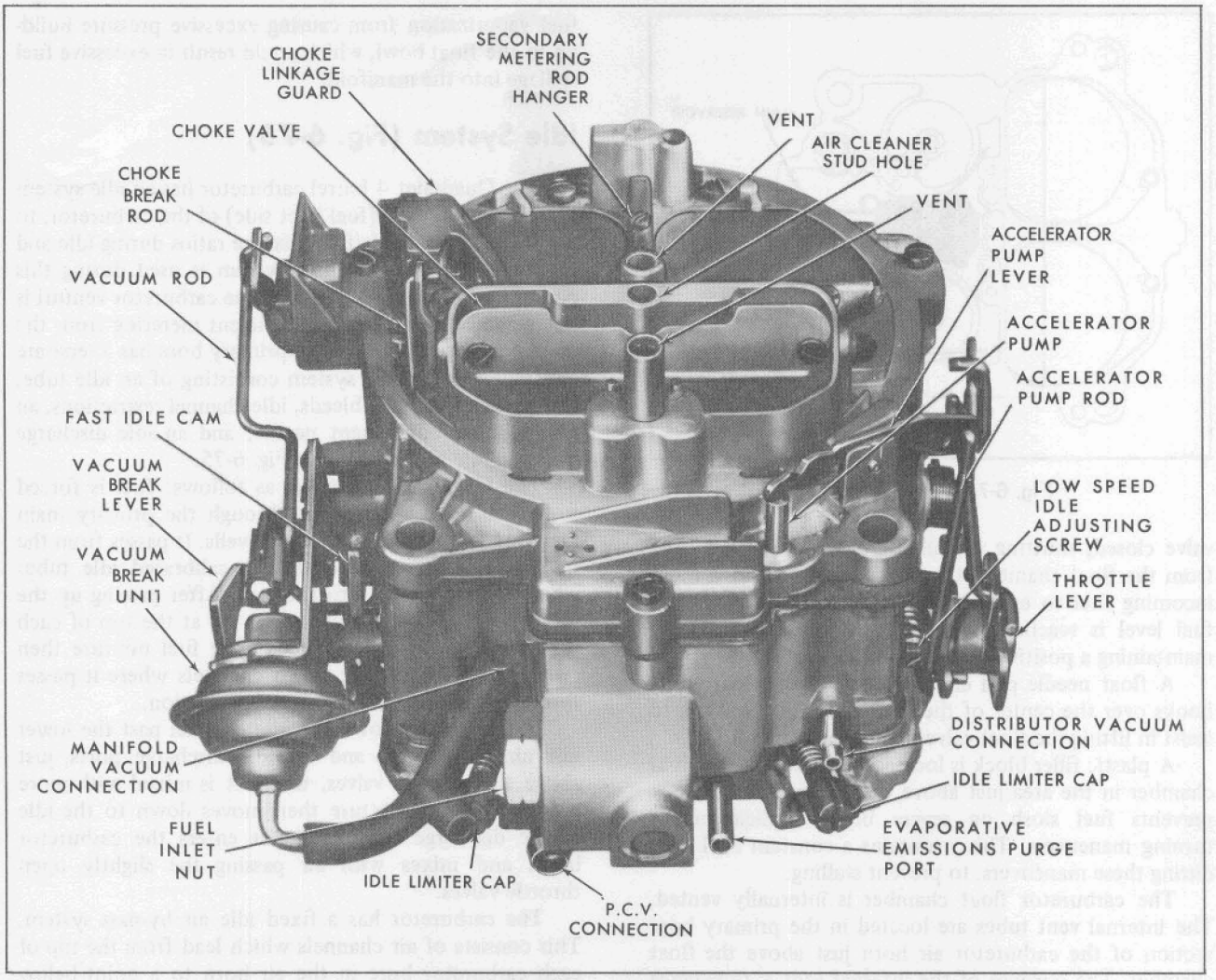


Fig. 6-72 Quadrajet 4MV Carburetor

metering in the primary side is accomplished with metering rods, operating in main metering jets, positioned by a power piston responsive to manifold vacuum. The secondary side has two very large bores to supplement air and fuel flow from the primary bores. The air valve principle is used in the secondary side for metering control, which means that fuel is metered in direct proportion to the air passing through the secondary bores.

The fuel reservoir (float bowl) is centrally located. The float system uses a single float pontoon. The float needle has a synthetic tip which gives added protection against flooding problems caused by dirt.

Idle mixture adjustment limiter caps are used on the idle mixture screws. The idle mixture is pre-set and capped with the plastic caps. Once adjusted, the idle mixture screws are held in a positive position and should not be readjusted in the field. If necessary to clean or overhaul the carburetor, new red limiter caps are provided in the repair kit. Complete instructions for readjustment of the idle mixture is described in Note 77.

The fuel tank is not vented to atmosphere. All fuel vapors are collected in a vapor canister. Purge ports to remove the fuel vapors from the collection canister are provided in the carburetor throttle body. Purging is varied by a timed port positioned above the throttle valves and is controlled by the amount of primary throttle valve opening.

The pull over enrichment circuit has been redesigned in that the discharge ports are located above the choke valve to provide improved fuel control at higher engine speeds and carburetor air flows.

Float System (Figs. 6-73 and 6-74)

The Quadrajet carburetor has a centrally located float reservoir with a single pontoon float and a conventional float needle valve and seat. The fuel bowl is centered between the primary bores and is adjacent to the secondary bores as shown in Fig. 6-73.

The float system consists of a float chamber, pontoon assembly made of a closed cellular plastic material, float hinge pin, a float needle valve and seat, and a float valve pull clip. The float system operates as follows:

Fuel from the engine fuel pump enters the carburetor fuel inlet passage in Fig. 6-74. It passes through the inlet screen, and needle seat.

As fuel fills the float bowl to the prescribed fuel level, the float pontoon rises and forces the fuel inlet

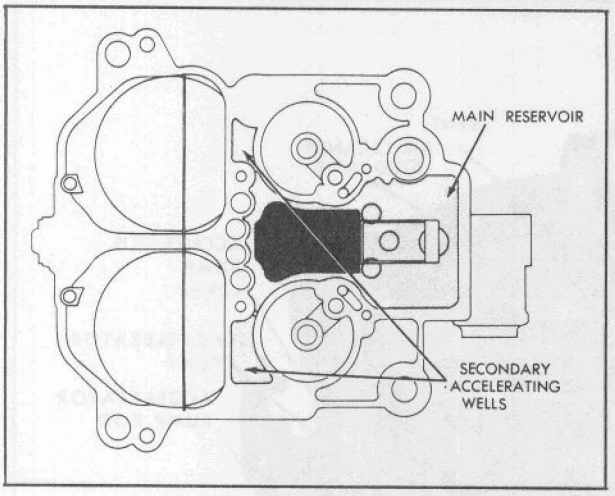


Fig. 6-73 Fuel Reservoir

valve closed, shutting off all full flow. As fuel is used from the float chamber, the float drops and allows more incoming fuel to enter the float bowl until the correct fuel level is reached. This cycle continues, constantly maintaining a positive fuel level in the float bowl.

A float needle pull clip, fastened to the float valve, hooks over the center of the float arm. Its purpose is to assist in lifting the float valve off its seat.

A plastic filler block is located in the top of the float chamber in the area just above the fuel inlet. This block prevents fuel slosh on severe brake applications or turning maneuvers. This maintains a constant fuel level during these maneuvers, to prevent stalling.

The carburetor float chamber is internally vented. The internal vent tubes are located in the primary bore section of the carburetor air horn just above the float chamber. The purpose of the internal vent is to balance incoming air pressure beneath the air cleaner with air pressure acting on fuel in the float bowl. Thereby maintaining a balanced air/fuel mixture ratio during part throttle and power operation, because the pressure acting upon the fuel in the float bowl will be balanced with the air flow through the carburetor bores. The internal vent tubes allow the escape of fuel vapors in the float chamber during hot engine operation. This prevents fuel vaporization from causing excessive pressure build-up in the float bowl, which could result in excessive fuel spillage into the manifold.

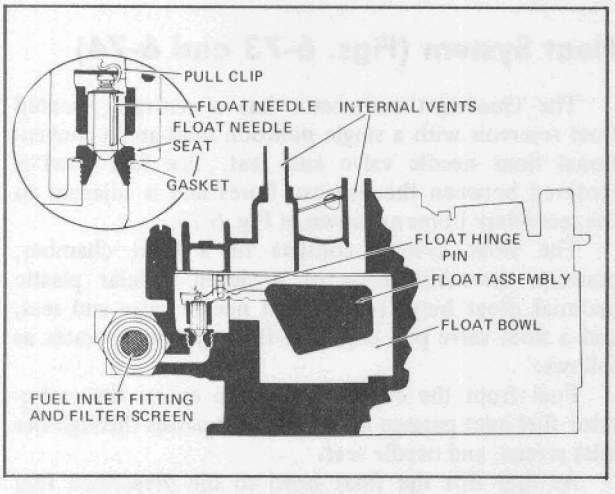


Fig. 6-74 Float System

Idle System (Fig. 6-75)

The Quadrajet 4 barrel carburetor has an idle system on the primary side (fuel inlet side) of the carburetor, to supply the correct air/fuel mixture ratios during idle and off idle operation. The idle system is used during this period because air flow through the carburetor venturi is not great enough to obtain efficient metering from the main discharge nozzles. Each primary bore has a separate and independent idle system consisting of an idle tube, idle passages, idle air bleeds, idle channel restrictions, an idle mixture adjustment needle, and an idle discharge hole and idle air passage. See Fig. 6-75.

The idle system operates as follows: fuel is forced from the float bowl down through the primary main metering jets into the main fuel wells. It passes from the main fuel well up through the calibrated idle tubes which extend down into the well. After passing up the idle tube, the fuel is mixed with air at the top of each tube through an idle air bleed. The fuel mixture then crosses over to the idle down channels where it passes through a calibrated idle channel restriction.

It then passes down the idle channel past the lower idle air bleed holes and off idle discharge ports, just above the throttle valves, where it is mixed with more air. The air/fuel mixture then moves down to the idle needle discharge holes where it enters the carburetor bores and mixes with air passing the slightly open throttle valves.

The carburetor has a fixed idle air by-pass system. This consists of air channels which lead from the top of each carburetor bore in the air horn to a point below each primary throttle valve. At normal idle, extra air passes through these channels supplementing the air passing by the slightly opened throttle valves. The purpose of the idle air by-pass system is to allow reduction in the amount of air going past the throttle valves so that they can be nearly closed at idle. This reduces the amount of air flowing through the carburetor venturi to

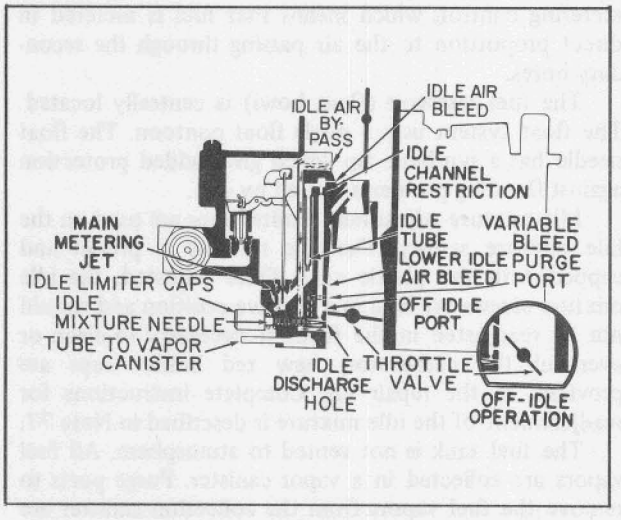


Fig. 6-75 Idle System

prevent the main fuel nozzles from feeding during idle operation. The venturi system is very sensitive to air flow and on these applications where larger amounts of idle air are needed to maintain higher idle speeds, the fixed idle air by-pass system is used.

As mentioned, the fuel tank will not be vented to atmosphere and all fuel vapors are collected in a vapor collection canister from the fuel tank vent. In order to remove the fuel collected in the vapor canister, it is necessary to provide a means of purging the canister and burning the vapors in the engine.

Purge ports for the vapor collection canister are provided in the carburetor throttle body. The ports are located slightly above the throttle valves during the idle position of the valve. As the throttle valves are opened to the off idle position, the purge ports are in the low pressure area and begin to remove fuel vapors from the vapor canister. The purge ports are relatively large and provide adequate purge to remove all vapors collected in the canister. They will bleed constantly in varying amounts during off idle, part throttle, and wide open throttle operation of the engine.

Off Idle Operation

As the primary throttle valves are opened from curb idle to increase engine speed, additional fuel is needed to combine with the extra air entering the engine. This is accomplished by the slotted off-idle discharge ports. As the primary throttle valves open, they pass by the off-idle ports, gradually exposing them to high engine vacuum below the throttle valves. The additional fuel added from the off-idle ports mixes with the increasing air flow past the opening throttle valves to meet increased engine air and fuel demands.

Further opening of the throttle valves increases the air velocity through the carburetor venturi sufficiently to cause low pressure at the lower idle air bleeds. As a result, fuel begins to discharge from the lower idle air bleed holes (located at the bottom of the large venturi skirt) and continues to do so throughout operation of the part throttle to wide open throttle ranges, supplementing the main discharge nozzle delivery.

The idle mixture needle holes and off-idle discharge ports continue to supply sufficient fuel for engine requirements until air velocity is high enough in the venturi area to obtain efficient fuel flow from the main metering system.

Main Metering System (Fig. 6-76)

The main metering system supplies fuel to the engine from off-idle to wide open throttle operation. The Quadrajet carburetor has two bores that feed fuel and air during this range. The two primary bores of the carburetor meter fuel through the venturi principle. This design allows the use of multiple venturi for finer, more stable and accurate metering control during light engine loads.

The main metering system is in operation at all times when air flow through the venturi is high enough to maintain efficient fuel flow from the main fuel discharge nozzles. It begins to feed fuel when the idle system can no longer meet the engine requirements.

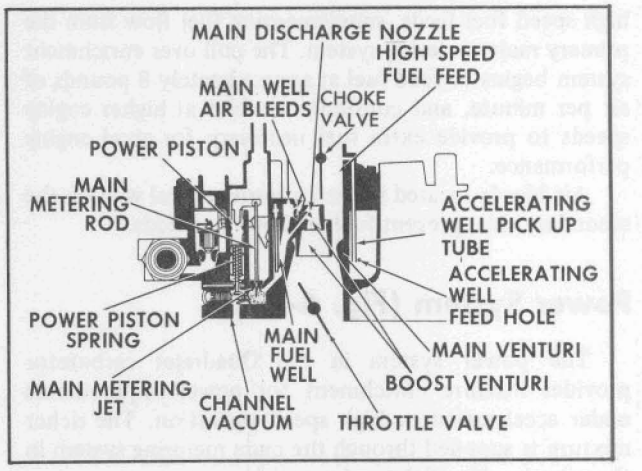


Fig. 6-76 Main Metering System

The main metering system consists of main metering jets; vacuum operated metering rods; main fuel well; main well air bleeds; fuel discharge nozzles; and triple venturi. The system operates as follows:

During cruising speeds and light engine loads, engine manifold vacuum is high. Manifold vacuum holds the power piston and main metering rods down in contact with the adjustable part throttle screw and in the main metering jets. Manifold vacuum is supplied through a channel to the vacuum operated power piston connected to the primary main metering rods. Fuel flow from the float bowl is metered between the metering rods and the main metering jets.

As the primary throttle valves are opened beyond the off-idle range, allowing more air to enter the engine manifold, air velocity increases in the carburetor venturi. This causes a drop in pressure in the large venturi which is increased many times in the double boost venturi. Since the low pressure (vacuum) is now in the smallest boost venturi, fuel flows from the main discharge nozzles as follows:

Fuel flows from the float bowl through the main metering jets into the main fuel well and is bled with air from the vent at the top of the main well and side bleeds. The fuel in the main well is mixed with air from the main well air bleeds and then passes through the main discharge nozzle into the boost venturi. At the boost venturi the fuel mixture then combines with the air entering the engine through the carburetor bores and passes through the intake manifold and on into the engine cylinder as a combustible mixture.

A high speed fuel enrichment circuit referred to as pull over enrichment (POE), has been added to supplement fuel feed from the primary main discharge nozzles. The purpose of the supplementary fuel feeds is to allow the use of lean fuel mixtures during part throttle operation and still provide the extra fuel needed at higher engine speeds.

Two calibrated holes, one in each primary bore are located just above the choke valve and feed fuel from the float bowl. During high carburetor air flows, low pressure created in the air horn bore pulls fuel from the

high speed fuel feeds, supplementing fuel flow from the primary main metering system. The pull over enrichment system begins to feed fuel at approximately 8 pounds of air per minute, and continues to feed at higher engine speeds to provide extra fuel necessary for good engine performance.

Air bleeds located in the air horn vertical wall on the secondary side, prevent fuel feed at low speeds.

Power System (Fig. 6-77)

The power system in the Quadrajet carburetor provides mixture enrichment for power requirements under acceleration or high speed operation. The richer mixture is supplied through the main metering system in the primary side of the carburetor.

The power system located in the primary side consists of a vacuum piston and spring located in a cylinder connected by a passage to intake manifold vacuum. The spring located beneath the vacuum operated power piston tends to push the piston upward against manifold vacuum.

An "adjustable part throttle" feature has been designed to allow each carburetor to be individually calibrated at time of assembly. Each Cadillac carburetor will be adjusted by the manufacturer to provide the most ideal air-fuel ratio for low exhaust emissions. The adjustable part throttle screw is used to raise or lower the power piston and metering rods to provide this ratio. Upon completion of this adjustment the access hole is sealed and no further adjustment should be attempted. This adjustment should not be attempted in the field.

On part throttle and cruising ranges, manifold vacuum is sufficient to hold the power piston down against spring tension so that the larger diameter of the metering rod tip is held in the main metering jet orifice. Mixture enrichment is not necessary at this point. However, as engine load is increased to a point where mixture enrichment is required, the spring tension overcomes the vacuum pull on the power piston and the tapered primary metering rod tip moves upward in the main metering jet orifice. This smaller diameter of the metering rod tip allows more fuel to pass through the main metering jet and enrich the mixture flowing into the primary main wells and out the main discharge nozzles.

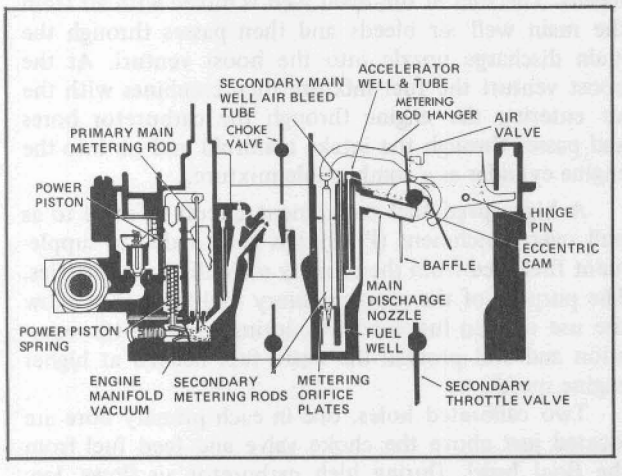


Fig. 6-77 Power System

When manifold vacuum rises and mixture enrichment is no longer needed, the vacuum overcomes the power piston spring tension and returns the larger portion of the metering rod into the metering jet orifice and back to normal economy ranges. However, as the engine speed and load increases further, the primary side of the carburetor can no longer meet the engine air and fuel requirements. To meet these demands, the secondary side of the carburetor is used. The secondary side contains throttle valves, spring loaded air valves, metering orifice plates, secondary metering rods, main fuel wells with air bleed tubes, fuel discharge nozzles, and accelerating wells and tubes. The secondary side operates as follows:

When the engine reaches a point where the primary bores cannot meet engine air and fuel demands, the primary throttle lever, working through connecting linkage to the secondary throttle shaft lever, begins to open the secondary throttle valves. As air flows through the secondary bores creating a low pressure (vacuum) beneath the air valve, atmospheric pressure on top of the air valve forces the air valve open against spring tension. This allows the required air for increased engine speed to flow past the air valve.

When the air valve begins to open, the upper edge of the air valve passes the accelerating well discharge port. As the valve passes the port it exposes the port to manifold vacuum. The port will immediately start to feed fuel from the accelerating wells.

The accelerating ports prevent a momentary leanness as the valve opens and the secondary nozzles have not begun to feed fuel. Discharge from the ports stops after the edge of the valve has passed the port.

The secondary main discharge nozzles (one for each secondary bore) are located just below the air valve and above the secondary throttle valves. Being in an area of low pressure, they begin to feed fuel as follows:

When the air valve begins to open, it rotates a plastic cam attached to the center of the main air valve shaft. The cam pushes upward on a lever attached to the secondary metering rods, raising the metering rods out of the secondary orifice plates. Fuel flows from the float chamber through the secondary orifice plates into secondary main wells, where it is mixed with air from the main well tubes at the bottom of the main wells. The air-blended-fuel mixture travels from the main wells to the secondary discharge nozzles and into the secondary bores. Here fuel mixture is mixed with air traveling through the secondary bores to supplement the air/fuel mixture delivered from the primary bores, and then goes on into the engine manifold and on to the engine cylinders as a combustible mixture.

As the throttle valves are opened further, and engine speeds increase, increased air flow through the secondary side of the carburetor opens the air valve to a greater degree, which in turn lifts the secondary metering rods further out of the orifice plates. The metering rods are tapered so that fuel flow through the secondary metering orifice plates is directly proportional to air flow through the secondary carburetor bores. In this manner correct air/fuel mixtures to the engine through

the secondary bores can be maintained by the depth of the metering rods in the orifice plates.

There are three other features incorporated in the secondary metering system which are as follows:

1. The main well bleed tubes extend below the fuel level in the main well. These bleed air into the fuel in the well to blend the fuel with air quickly for good atomization as it leaves the secondary discharge nozzles.

2. The secondary metering rods have a slot milled in the side to insure adequate fuel supply in the secondary fuel wells. These are necessary because, when the air valve is in the closed position, the secondary metering rods are nearly seated against the secondary metering orifice plates. During hot engine idle or hot soak the fuel could boil out of the fuel well. The milled slot allows enough fuel to by-pass the orifice plate to keep the main well filled during this period. This insures immediate fuel delivery from the secondary fuel wells at all times.

3. A baffle plate is used in the secondary bores. Its purpose is to provide good fuel distribution by preventing too much fuel from going to the front of the engine.

Air Valve Dashpot Operation (Fig. 6-78)

The secondary air valve is connected to a dashpot (called the vacuum break unit) by a rod, to control the opening rate of the air valve and prevent any secondary discharge nozzle lag.

Whenever manifold vacuum is above approximately 5" - 6" Hg, the vacuum break diaphragm system is seated. However, when the secondary valves are opened and manifold vacuum drops below the 5" - 6" point, the spring in the vacuum break unit will force the diaphragm and stem off its seat. The rate of movement of the seat is controlled by a restriction in the cover of the vacuum break unit.

When the diaphragm is seated, it pulls the rod to the front end of the slot in the air valve shaft lever. As the air valve starts to open, when the secondary throttle valves are opened, the restriction in the tube will restrict the air movement to the back side of the diaphragm and slow down the opening of the air valve.

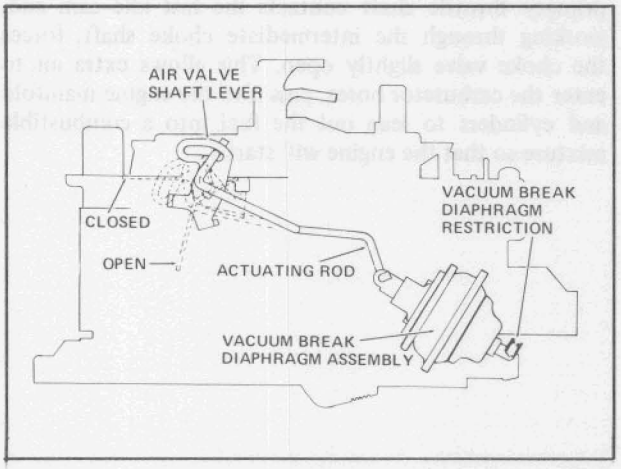


Fig. 6-78 Air Valve Dashpot Operation

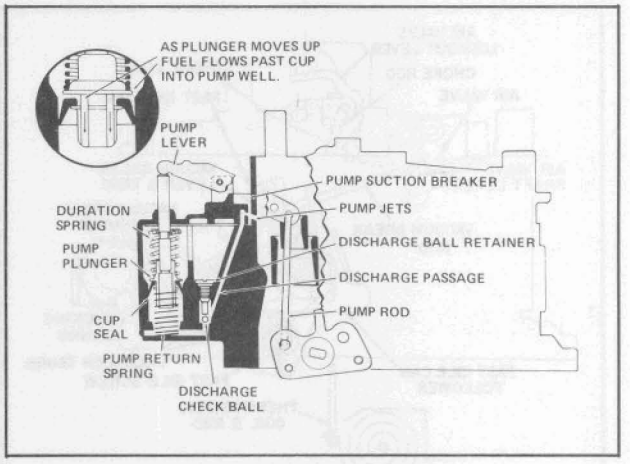


Fig. 6-79 Accelerator Pump System

Accelerating Pump System (Fig. 6-79)

During quick acceleration, when the throttle is opened rapidly, the air flow and manifold vacuum change almost instantaneously. The fuel, which is heavier, tends to lag behind causing a momentary leanness. The accelerator pump is used to provide the extra fuel necessary for smooth operation during this time.

The accelerating pump system is located in the primary side of the carburetor. It consists of a spring loaded pump plunger and pump return spring, operating in a fuel well. The pump plunger is operated by a pump lever on the air horn which is connected directly to the throttle lever by a pump rod.

When the pump plunger moves upward in the pump well, as happens during throttle closing, fuel from the float bowl enters the pump well through a slot in the top of the pump well. It flows past the synthetic pump cup seal into the bottom of the pump well. The pump cup is a floating type which moves up and down on the pump plunger head. When the pump plunger is moved upward, the flat on top of the cup unseats from the flat on the plunger head and allows free movement of fuel through the inside of the cup into the bottom of the pump well. This also vents any vapors which may be in the bottom of the pump well so that a solid charge of fuel can be maintained in the fuel well beneath the plunger head.

When the primary throttle valves are opened, connecting linkage forces the pump plunger downward. The pump cup seats instantly and fuel is forced through the pump discharge passage, where it unseats the pump discharge check ball and passes on through the passage to the pump jets located in the air horn where it sprays into the venturi area of each primary bore.

It should be noted the pump plunger is spring loaded. The upper duration spring is balanced with the bottom pump return spring so that a smooth sustained charge of fuel is delivered during acceleration.

The pump discharge check ball seats in the pump discharge passage during upward motion of the pump plunger so that air will not be drawn into passage; otherwise, a momentary acceleration lag could result.

During high speed operation, a vacuum exists at the pump jets. A cavity just beyond the pump jets is vented

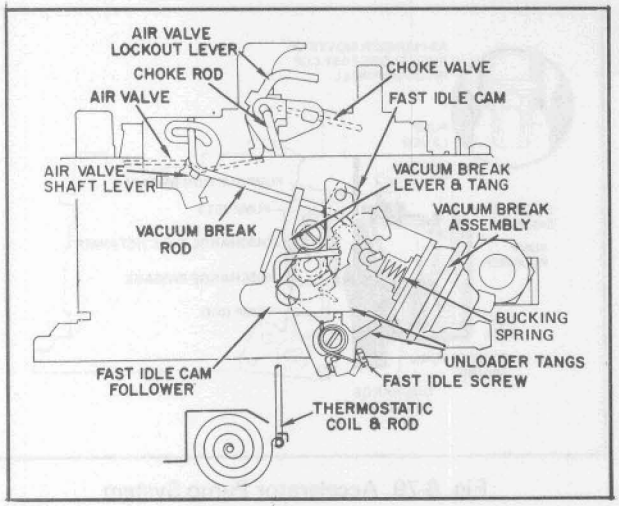


Fig. 6-80 Choke System

to the top of the air horn, outside the carburetor bores. This acts as a suction break so that when the pump is not in operation fuel will not be pulled out of the pump jets into the venturi area. This insures a full pump stream when needed and prevents any fuel "pull over" from the pump discharge passage.

Choke System (Fig. 6-80)

The Quadrajet choke valve is located in the primary side of the carburetor. It provides the correct air/fuel mixture enrichment to the engine for quick cold engine starting and during the warm-up period. The air valve is locked partially closed until the engine is thoroughly warm and choke valve is wide open. The air valve can open a maximum of 10° during warm-up to permit increased performance.

The choke system consists of a choke valve located in the primary air horn bore, a vacuum break unit, fast idle cam, connecting linkage, air valve lockout lever and a thermostatic coil. The thermostatic coil is connected to the intermediate choke shaft and lever assembly. Choke operation is controlled by the combination of intake manifold vacuum, the off-set choke valve, temperature, and throttle position.

The thermostatic coil located on the engine manifold is calibrated to hold the choke valve closed when the engine is cold.

(NOTE: To close the choke valve, the primary throttle valves have to be opened to allow the fast idle cam follower to by-pass the steps on the fast idle cam and come to rest on the highest step of the cam.)

When the choke valve is closed, the air valve lock-out lever is weighed so that a tang on the lever catches the upper edge of the air valve permitting only 6°-10° of air valve opening.

During engine cranking, the choke valve is held closed by the tension of the thermostatic coil. This restricts air flow through the carburetor to provide a richer starting mixture. When the engine starts and is running, manifold vacuum applied to the vacuum break unit mounted on the float bowl will open the choke valve to a point where the engine will run without loading or stalling.

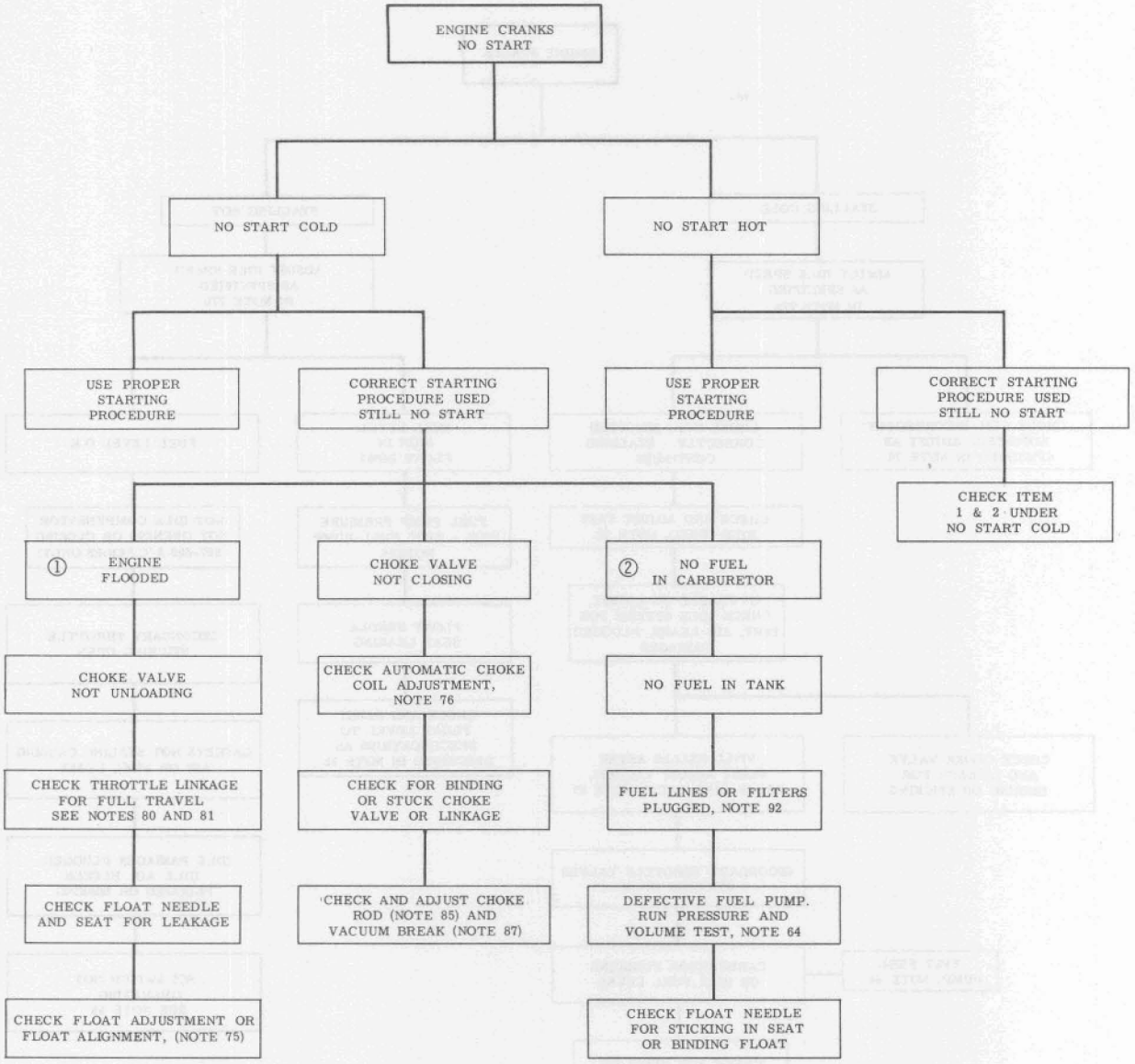
Included in the vacuum break unit is a spring loaded plunger. The purpose of the spring is to off-set choke thermostatic coil tension to provide leaner mixtures during warm up for reduced exhaust emissions. In colder temperatures, tension created by the thermostatic coil will overcome the tension of the plunger spring and provide less choke valve opening with a resultant slightly richer mixture. In warmer temperatures the thermostatic coil will have less tension and, consequently, will not compress the spring as much, thereby, giving a greater choke valve opening for slightly leaner mixtures.

This gives the engine sufficient fast idle and correct fuel mixture for running until the engine begins to warm up and heat the thermostatic coil. As the thermostatic coil on the engine manifold becomes heated, it relaxes its tension and allows the choke valve to open further because of intake air pushing on the off-set choke valve and the counterweight effect of the linkage and choke lever. Choke valve opening continues until the thermostatic coil is completely relaxed, at which point the choke valve is wide open.

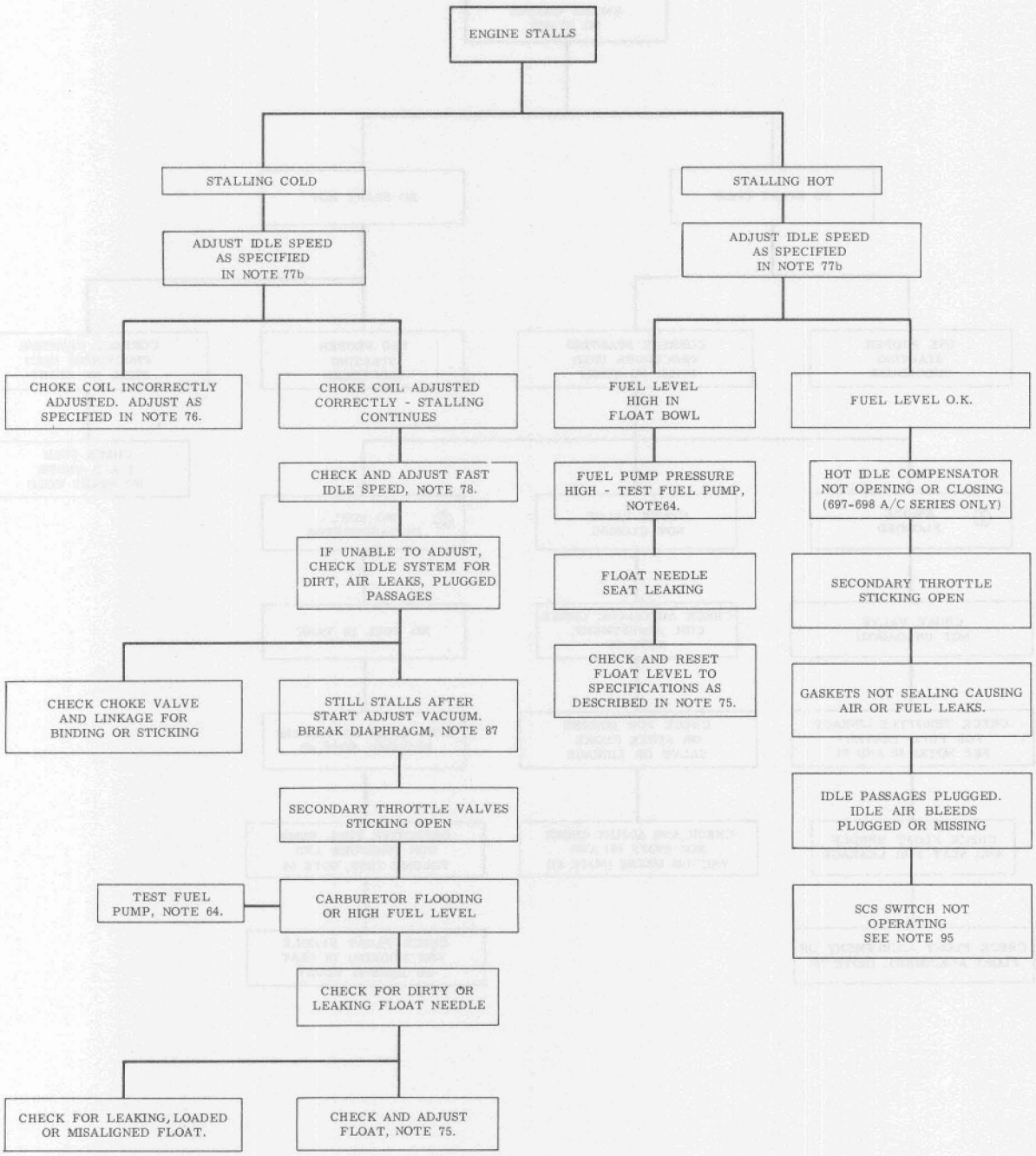
When the engine is thoroughly warm, the choke coil allows the vacuum break lever to come down. When the choke shaft lever moves toward the up position, the end of the choke rod strikes a tang of the air valve lock-out lever. As the rod moves to the end of its travel, it pushes the lock-out tang upward, unlocking the air valve.

The choke system is equipped with an unloader mechanism which is designed to open the choke valve partially if the engine should become loaded or flooded. To unload the engine, the accelerator pedal must be depressed to the floor so that the throttle valves are held wide open. A tang on a lever on the choke side of the primary throttle shaft contacts the fast idle cam and, working through the intermediate choke shaft, forces the choke valve slightly open. This allows extra air to enter the carburetor bores, pass into the engine manifold and cylinders to lean out the fuel into a combustible mixture so that the engine will start.

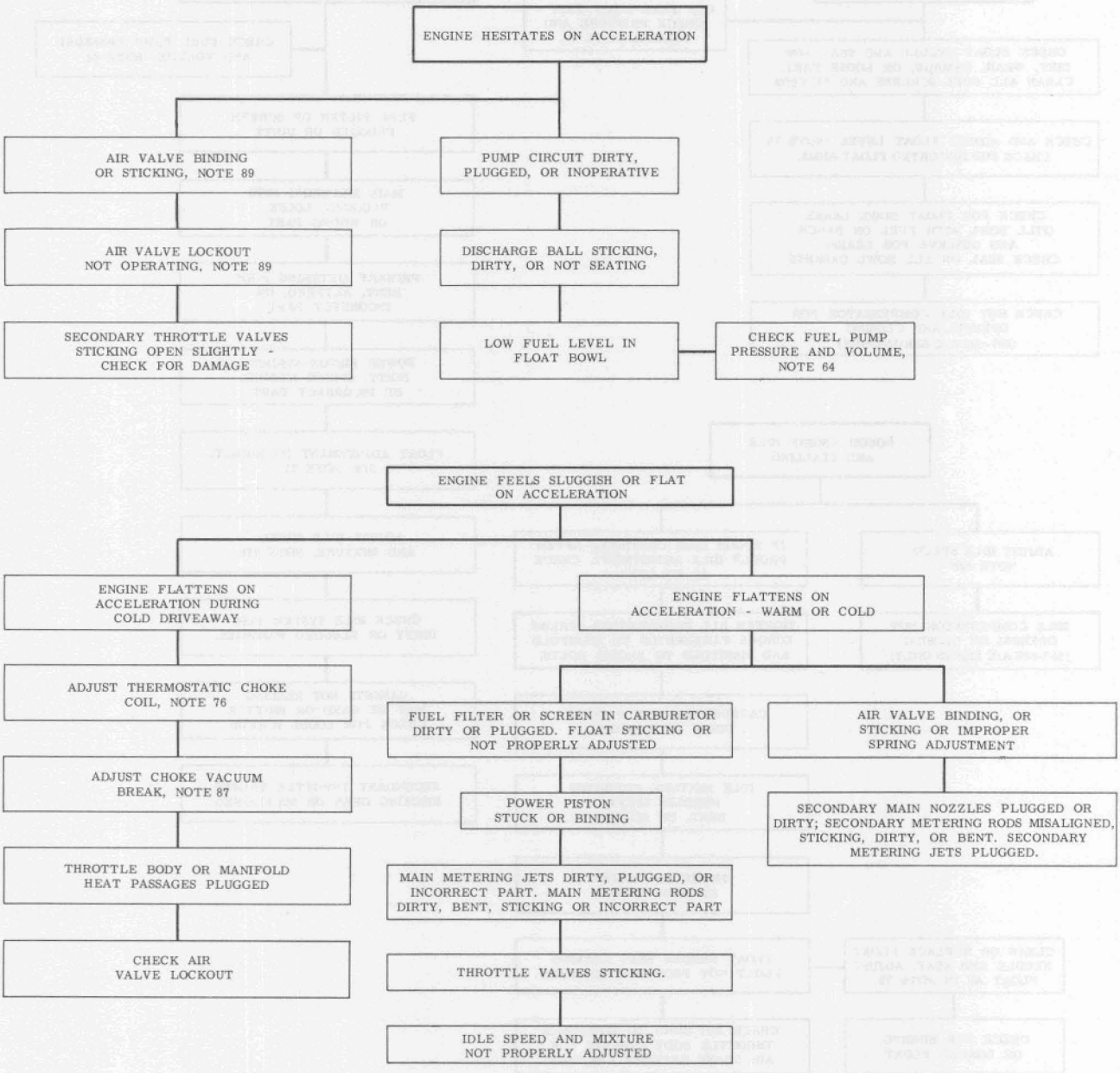
QUADRAJET 4MV CARBURETOR DIAGNOSIS CHART



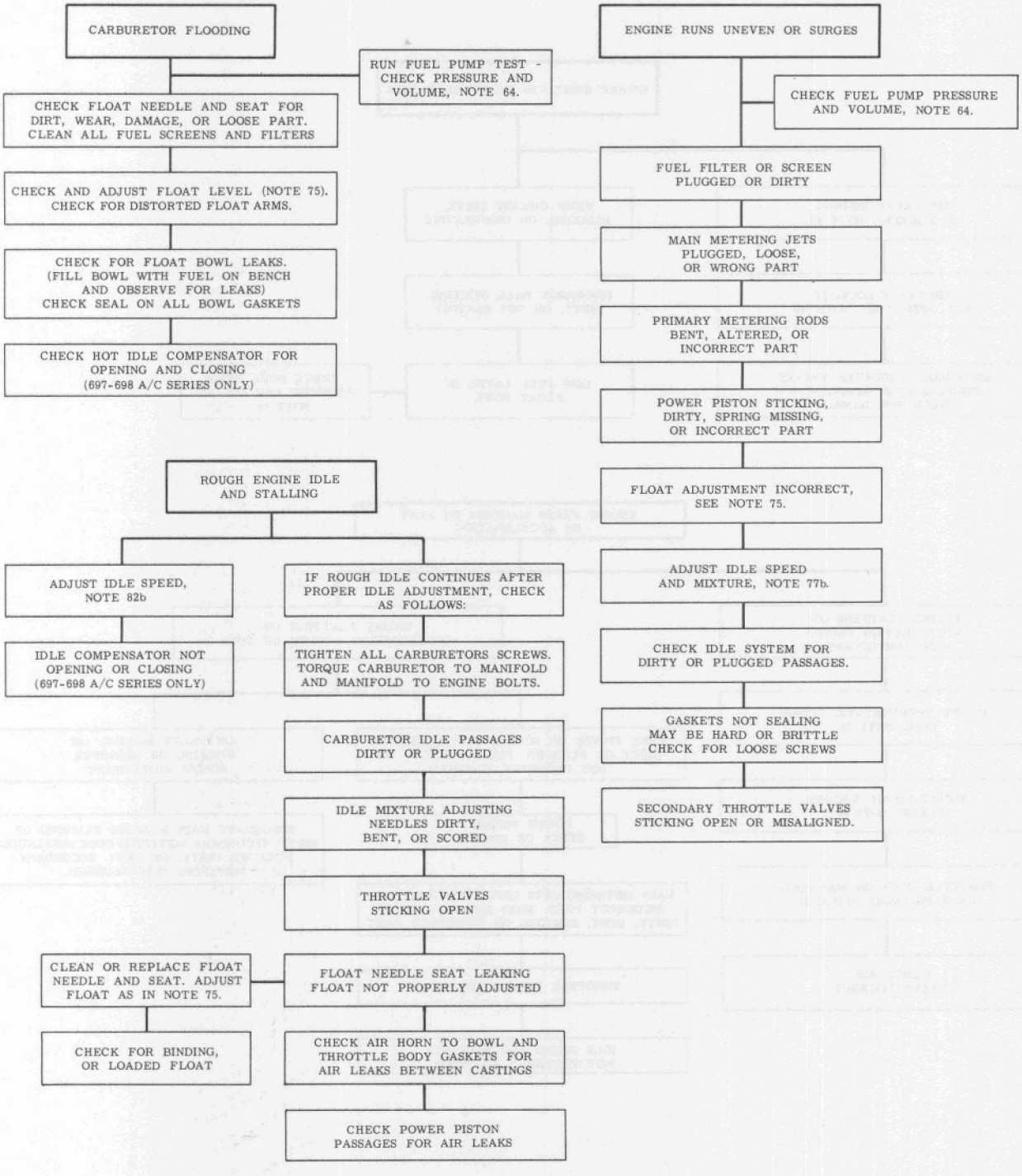
QUADRAJET 4MV
CARBURETOR DIAGNOSIS CHART (Cont'd.)



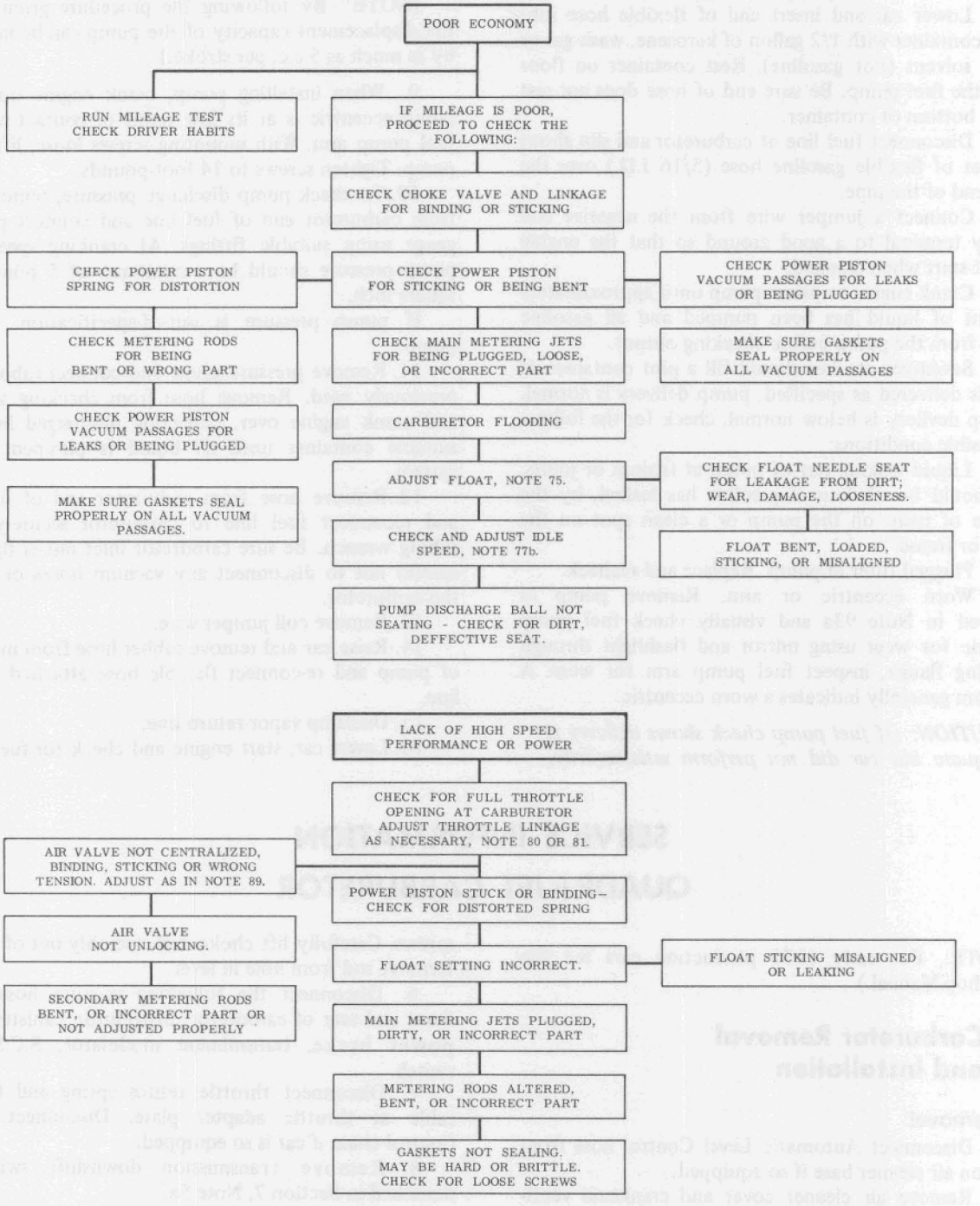
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QUADRAJET 4MV
CARBURETOR DIAGNOSIS CHART (Cont'd.)



QUADRAJET 4MV
CARBURETOR DIAGNOSIS CHART (Cont'd.)



64. Fuel Pump Tests

1. To check fuel pump capacity, raise car and disconnect fuel inlet hose at the pump and plug. On cars with A/C clamp off vapor return line; do not remove from pump (Use towel to absorb slight gas drainage.)

2. Connect about 2 feet of flexible gasoline hose (5/16 I.D.) to the fuel pump inlet nipple.

3. Lower car and insert end of flexible hose into gallon container with 1/2 gallon of kerosene, wash gas or similar solvent (not gasoline). Rest container on floor below the fuel pump. Be sure end of hose does not rest against bottom of container.

4. Disconnect fuel line at carburetor and slip about two feet of flexible gasoline hose (5/16 I.D.) over the flared end of the pipe.

5. Connect a jumper wire from the negative coil primary terminal to a good ground so that the engine will not start when cranked.

6. Crank engine to prime pump until approximately 1/2 pint of liquid has been pumped and all gasoline purged from the pump before checking output.

7. Seventeen strokes should fill a pint container. If liquid is delivered as specified, pump delivery is normal. If pump devliery is below normal, check for the following possible conditions:

a. Liquid leaking out of pump at fittings or joints. This should be obvious if gasoline has leaked, by the absence of paint on the pump or a clean spot on the engine or frame.

b. Plugged filter in pump. Replace and recheck.

c. Worn eccentric or arm. Remove pump as described in Note 93a and visually check fuel pump eccentric for wear using mirror and flashlight through mounting flange, inspect fuel pump arm for wear. A worn arm generally indicates a worn eccentric.

CAUTION: If fuel pump check shows delivery is adequate but car did not perform satisfactorily, check for pinched, damaged, or leaky fuel inlet line and hoses back to the tank and discharge line to carburetor and the vapor return line. Check for a plugged filter in the gas tank. Replace damaged or defective parts.

8. If pump does not operate properly after these check have been made, replace pump.

(NOTE: By following the procedure given below, the displacement capacity of the pump can be increased by as much as 5 c.c. per stroke.)

9. When installing pump, crank engine until fuel pump eccentric is at its low point of contact with the fuel pump arm. With mounting screws loose, lift up on pump. Tighten screws to 14 foot-pounds.

10. To check pump discharge pressure, remove hose from carburetor end of fuel line and connect pressure gauge using suitable fittings. At cranking speed, fuel pump pressure should be a minimum of 5 pounds per square inch.

If pump pressure is out-of-specification, replace pump.

11. Remove pressure gauge and connect rubber hose previously used. Remove hose from checking solution and crank engine over, collecting discharged liquid in suitable container until all liquid is pumped out of system.

12. Remove hose from carburetor end of fuel line and reconnect fuel line to carburetor securely using tubing wrench. Be sure carburetor inlet nut is tight. Be careful not to disconnect any vacuum hoses or tees at the carburetor.

13. Remove coil jumper wire.

14. Raise car and remove rubber hose from inlet side of pump and re-connect flexible hose attached to fuel line.

15. Unclamp vapor return line.

16. Lower car, start engine and check for fuel leaks.

SERVICE INFORMATION
QUADRAJET CARBURETOR

(NOTE: For early 1972 production cars see the 1971 Shop Manual.)

65. Carburetor Removal and Installation

a. Removal

1. Disconnect Automatic Level Control hose from elbow on air cleaner base if so equipped.

2. Remove air cleaner cover and crankcase ventilating breather. Disconnect sensor vacuum hose.

3. Remove air cleaner and heat tube as a unit.

4. Disconnect fuel line at carburetor. Use a 1" tubing wrench, J-23443, if necessary to keep the inlet nut from turning.

5. Disconnect choke coil rod from carburetor by removing two choke housing to manifold attaching screws. Carefully lift choke coil assembly out of pocket. Remove rod from hole in lever.

6. Disconnect the following vacuum hoses from front and rear of carburetor: distributor, canister purge, power brake, transmission modulator, S.C.S.–V.S. switch.

7. Disconnect throttle return spring and throttle cable at throttle adapter plate. Disconnect Cruise Control chain if car is so equipped.

8. Remove transmission downshift switch as described in Section 7, Note 5a.

9. Remove two front screws and two rear screws that hold carburetor to intake manifold and lift carburetor off manifold slightly. Release PCV valve hose clamp attached to front of carburetor and remove hose from fitting.

10. Remove carburetor and gasket. Discard the carburetor gasket.

b. Installation

1. Clean surface of intake manifold and carburetor of any dirt, carbon or gasket material.

2. Place new carburetor gasket on top of manifold with side marked "Top" or with manufacturer's trade mark facing up.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD A STAINLESS STEEL SHIM (AS USED IN PREVIOUS YEARS) BE USED WHEN INSTALLING THE CARBURETOR.)

3. Connect PCV valve hose to fitting on front of carburetor and secure with clamp.

4. Position carburetor on intake manifold.

5. Install four mounting screws to intake manifold. Tighten screws evenly. Tighten front screws to 10 foot-pounds and rear screws to 14 foot-pounds.

(NOTE: This torque must be as specified to allow for accurate installation of calibrated choke coil rod.)

6. Connect distributor vacuum hose to distributor vacuum nipple at front of carburetor. Connect the S.C.S.–V.S. switch vacuum hose to rubber "tee" at front of carburetor. Connect power brake, transmission modulator and vacuum solenoid switch hoses to rear of carburetor. Install clamp on power brake hose and connect canister purge hose to fitting at front of throttle body.

7. Install choke coil rod into vacuum break lever as the choke assembly is installed to the manifold. Tighten choke assembly to manifold with attaching screws.

8. Install transmission downshift switch as described in Section 7, Note 5b.

9. Connect carburetor fuel line at carburetor and tighten all threaded fittings securely.

10. Connect throttle linkage and return spring.

11. Connect Cruise Control chain if so equipped.

12. If removed, place air cleaner gasket in position and install base of air cleaner on carburetor.

13. Connect vacuum hose at bottom of air cleaner to vacuum tee at rear of manifold.

14. Install crankcase ventilating breather into grommets in air cleaner base and left hand rocker arm cover.

15. Position heat tube over shroud outlet and press parts together.

16. Install air cleaner element and cover; secure with wing nut.

17. Connect Automatic Level Control hose to small elbow on air cleaner if car is so equipped.

66. Air Horn Removal

1. Remove secondary locknut guard by removing one self-tapping screw and one intermediate length air horn screw.

2. Remove horseshoe clip from upper end of choke rod, disconnect choke rod from upper choke shaft lever and remove choke rod from bowl. Use a thin screwdriver to push the lower choke lever outward to help remove the rod.

3. Using a pin punch, carefully drive accelerator pump roll pin out of boss only enough to lift pump arm out of way.

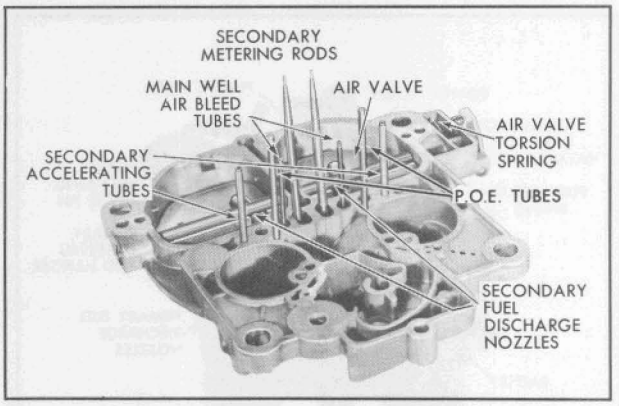


Fig. 6-81 Air Horn Assembly

4. Remove secondary metering rod hanger screw and remove metering rods with hanger.

5. Remove remaining air horn to bowl attaching screws, two long screws, five short screws, two countersunk screws. Two countersunk attaching screws are located inside air horn next to the primary venturi.

6. Lift air horn off bowl and twist to disengage vacuum break rod from air valve shaft. Air horn gasket should remain on bowl for removal later.

7. Remove vacuum break rod from vacuum break diaphragm plunger.

CAUTION: Care must be taken not to bend the small tubes protruding from air horn, Fig. 6-81. These are permanently pressed into the casting.

67. Air Horn Disassembly

(NOTE: Further disassembly of the air horn is not required for cleaning purposes and is not recommended. If part replacement is required, proceed as follows:)

1. Remove choke valve attaching screws and then remove choke valve and shaft.

2. Remove pump lever roll pin.

3. Remove air valve lockout lever roll pin and remove lever.

CAUTION: Air valves and air valve shaft are calibrated and should not be removed. However, should it be necessary to replace the plastic air valve cam on the air valve shaft, a repair kit is available which includes the plastic cam, closing spring, pin, screw and instructions.

68. Float Bowl Disassembly

1. Remove air horn assembly as described in Note 66.

2. Remove accelerator pump plunger from pump well, Fig. 6-82.

3. Remove air horn gasket from dowels on secondary side of bowl, then remove gasket from around power piston and primary metering rods.

4. Remove pump return spring from pump well.

5. Remove hot idle compensator and cork O-ring from float bowl on 697 and 698 A/C series only.

6. Remove plastic filler over fuel inlet needle and seat.

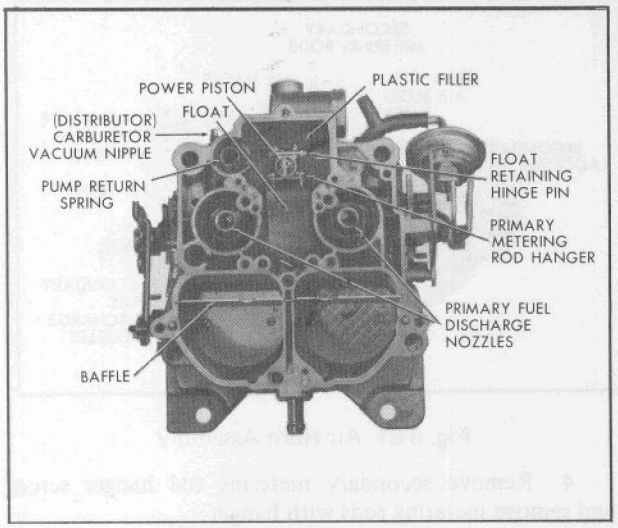


Fig. 6-82 Float Bowl Assembly

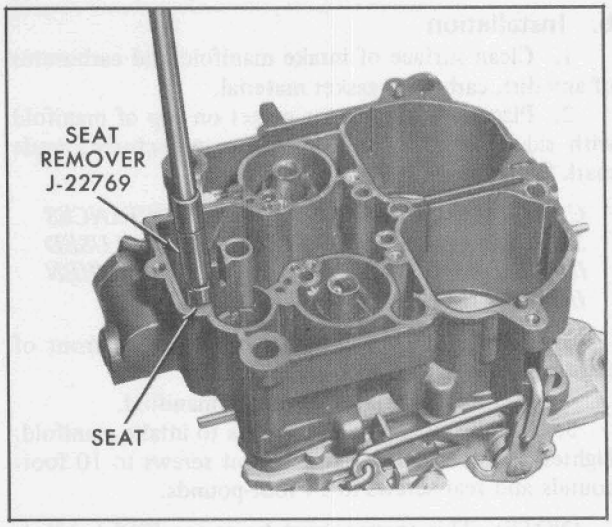


Fig. 6-84 Removing Needle Valve Seat

7. The power piston can be easily removed by pressing the piston down and releasing it. This will cause the power piston spring to snap the piston up against the retainer. In some cases this may have to be repeated several times. Remove power piston retainer clip and remove power piston and primary metering rods. Fig. 6-83. Remove power piston spring from well.

8. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotating rod to remove from hanger. See inset of Metering Rod Assembly, Fig. 6-87. Identify metering rods so that they may be reinstalled in the same jets from which they were removed.

9. Remove float assembly and inlet needle by pulling up on retaining hinge pin. Do not remove inlet needle seat unless it is damaged, in which case it and fuel needle must be replaced as an assembly. If needle seat is to be removed, use Fuel Inlet Needle Seat Remover, J-22769, Fig. 6-84.

10. Do not remove primary metering jets, Fig. 6-85 unless damaged or worn. No attempt should be made to remove secondary metering plates. If jets are removed but not replaced, they should be installed in the same hole from which they were removed.

11. Remove pump discharge check ball retainer screw and check ball.

12. Remove vacuum hose from vacuum break assembly and from tube connection on bowl.

13. Remove retaining screw from vacuum break assembly and remove assembly from float bowl.

(NOTE: If further disassembly of vacuum break mechanism is necessary, spread the retaining ears on bracket next to vacuum break assembly, then remove vacuum break assembly from bracket.)

14. Remove choke rod actuating lever from inside of float bowl well.

15. Remove fuel inlet nut, gasket and strainer.

16. Turn bowl over and remove throttle body by removing two throttle body to bowl attaching screws. See Fig. 6-86.

(NOTE: Be careful when inverting bowl assembly as smallest venturi protrudes beyond the gasket surface.)

17. Remove throttle body to bowl insulator gasket.

69. Throttle Body Disassembly

1. Remove pump rod from throttle lever by rotating rod out of lever.

2. Due to the addition of the idle mixture limiter caps, they should not be removed unless it is necessary

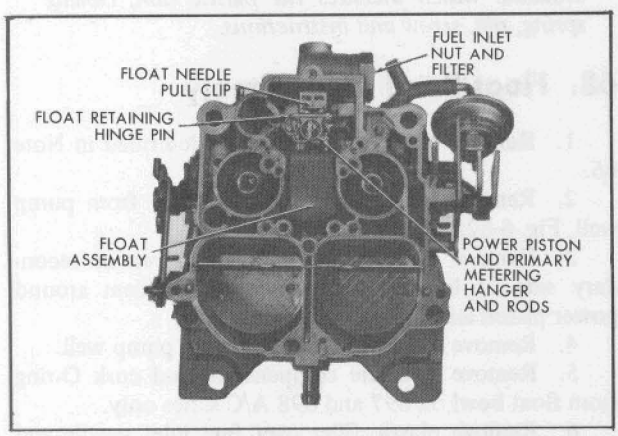


Fig. 6-83 Float Bowl Partially Disassembled

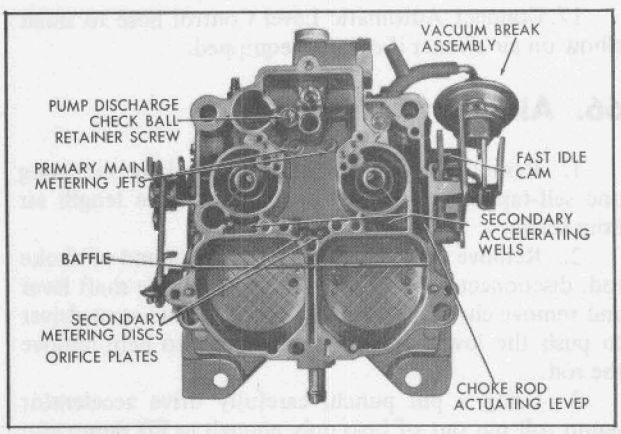


Fig. 6-85 Float Bowl Disassembled

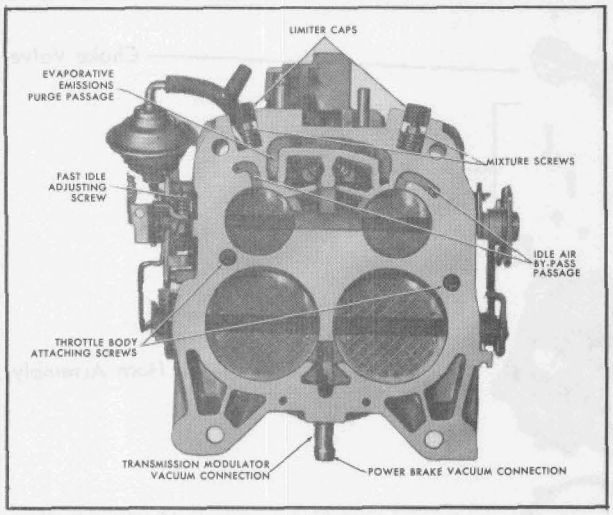


Fig. 6-86 Throttle Body

to replace the mixture needles or clean the idle passages. If the idle mixture needles are removed, adjustment procedures will be covered in Note 77. New plastic idle mixture limiter caps are provided in the repair kit. These should not be installed on the idle mixture needles until the mixture has been set according to instructions in Note 77.

CAUTION: Extreme care must be taken to avoid damaging throttle valves.

CAUTION: No further disassembly of the throttle body is required or desirable. Under no circumstances should the plug at the front of the throttle body be removed to adjust the screw behind it. The screw is factory set to control exhaust emission and pass U.S. Government standards. Since proper adjustment of the screw can only be made on an exhaust emission dynamometer or carburetor flow box, a new throttle body should be installed if any damage to the existing throttle body is encountered. Refer to Note 72 when installing throttle body.

70. Carburetor Cleaning and Inspection

1. Thoroughly clean carburetor castings and metal parts, Fig. 6-87 in an approved cold immersion type carburetor cleaner.

CAUTION: Rubber parts, plastic parts, and pump plungers, should NOT be immersed in carburetor cleaner. However, the cam on the air valve shaft will withstand normal cleaning in carburetor cleaner.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.
3. Inspect idle mixture needles for damage.
4. Examine fuel inlet needle and seat for wear. Replace, if necessary, with new needle and seat assembly.
5. Inspect upper and lower surface of carburetor castings for damage.
6. Inspect holes in levers for excessive wear or out of round conditions. If worn, levers should be replaced.
7. Examine fast idle cam for wear or damage.
8. Check air valve for binding conditions.
9. Check all throttle levers and valves for binds or other damage.
10. Clean plastic parts only in washing gas or kerosene.

Carburetor Assembly

71. Throttle Body Assembly

1. If removed, install idle mixture needles and springs until lightly seated. Back out needle 6 turns as a preliminary idle mixture adjustment. Do not install plastic idle limiter caps. A final adjustment must be made on the engine using the procedure described in Note 77.
2. Install lower end of pump rod into throttle lever by aligning tang on rod with slot in lever. End of rod should point outwards towards throttle lever.

72. Float Bowl Assembly

1. Install new throttle body to bowl insulator gasket on bowl, being certain gasket is properly positioned over two locating dowels.
2. Install throttle body, making certain that it is properly located over dowels on float bowl; then install two throttle body to bowl screws and tighten evenly and securely.

(NOTE: If a new (service) throttle body is used, be sure to perform step 20, of this note.)

Place carburetor on proper holding fixture.

3. Install fuel inlet strainer, new gasket, and inlet nut. Tighten nut securely.
4. If vacuum break diaphragm was removed from bracket slide vacuum break diaphragm between retaining ears and bend ears down slightly to hold securely.
5. Install fast idle cam on vacuum break assembly. Be sure arm of vacuum break lever is located beneath the tail of fast idle cam.
6. Connect choke rod (plain end) to choke rod actuating lever, then -- holding choke rod with grooved end pointing inward -- position choke rod actuating lever in well of float bowl and install choke assembly, engaging shaft with hole in actuating lever. Install retaining screw and tighten securely. Remove choke rod from lever for installation later.
7. Install vacuum hose tee to connections on bowl and vacuum break assembly.
8. Install pump discharge check ball and retainer screw in passage next to pump well.
9. If fuel inlet needle seat was removed, use new needle seat gasket and position new seat on Fuel Inlet Needle Seat Remover and Installer, J-22769. Carefully screw needle seat into float bowl, Fig. 6-84.
10. Install main metering jets. If removed, the jets should be installed in the same hole from which they were removed.
11. Install fuel inlet needle and pull clip.

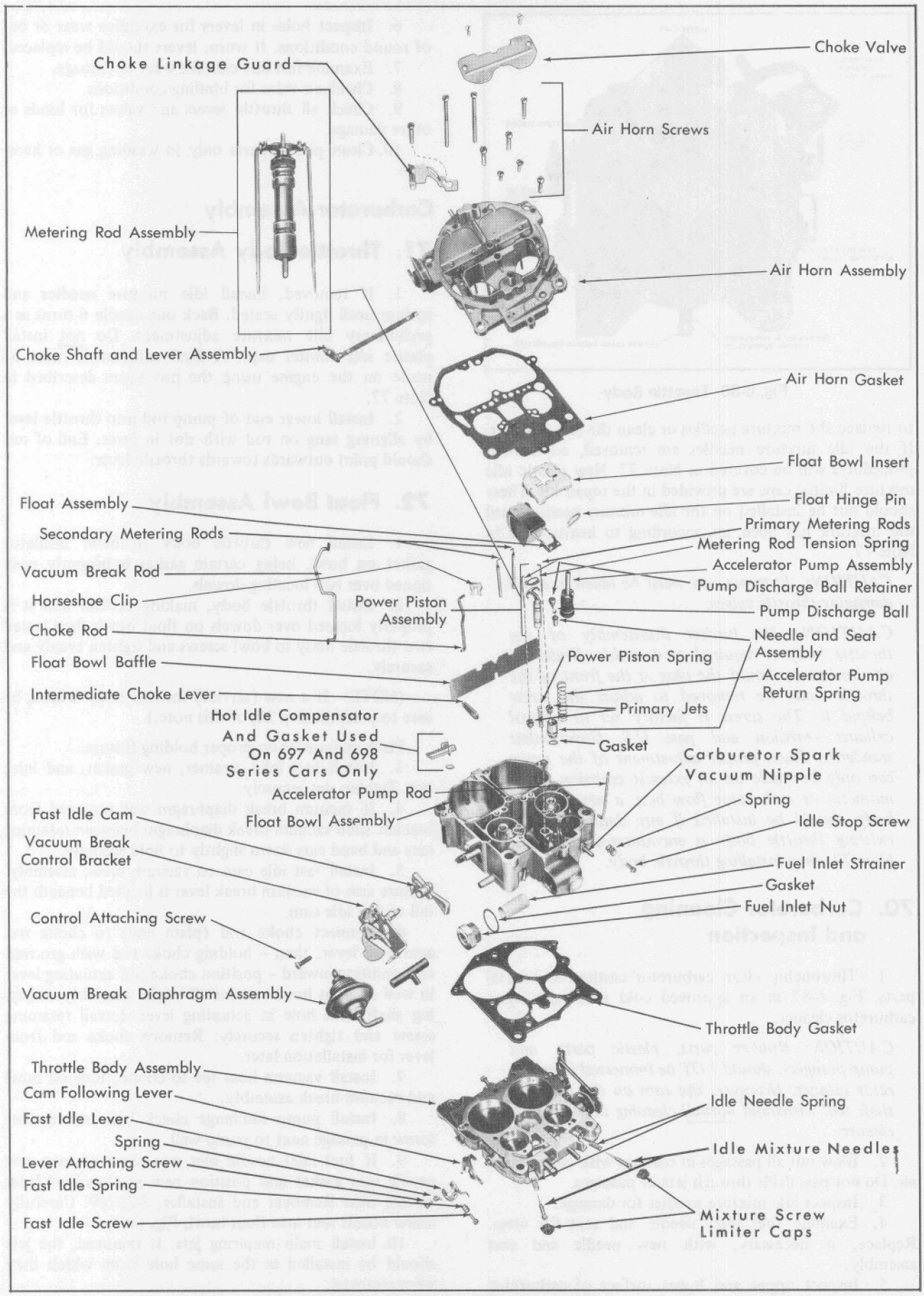


Fig. 6-87 Quadrajet 4MV Exploded View

12. Install float by sliding float lever under float needle pull clip. Pull clip should be positioned on the hinge pin side. With float lever in pull clip, hold float assembly at toe and install hinge pin from pump well side.

13. Perform float level adjustment as described in Note 75.

14. Install power piston spring in power piston well. If primary main metering rods were removed from hanger, reinstall, making sure that tension spring is connected to top of each metering rod. See Fig. 6-89. Rods must be positioned so they are installed in the same position from which they were removed. Install power piston assembly in well and metering rods properly positioned in metering jets. Install power piston retainer on top of power piston.

15. Install plastic filler over fuel inlet needle, pressing downward until seated properly.

16. Install pump return spring in pump well.

17. Install hot idle compensator O-ring seal in recess of bowl and position hot idle compensator on top (697 and 698 A/C series only).

18. Install air horn gasket around primary metering rods and piston. Position gasket over two dowels on secondary side of bowl.

19. Install pump plunger in pump well to complete float bowl assembly.

20. Whenever a service throttle body is installed, the following adjustment procedures must be followed carefully:

a. Seat the power piston assembly by pushing down on top of metering rod hanger.

b. At the front of the throttle body, recessed in the center, an adjusting screw is visible. This screw is plugged off except on service throttle bodies.

c. Back off the screw sufficiently so no motion of the power piston if felt.

d. Making sure the power piston assembly is completely down, turn the adjusting screw inward until it comes in contact with the power piston through a lever arrangement (concealed in the throttle body) and resistance to any further inward movement of the screw is noticed. Any further movement of the screw will begin to raise the power piston and can be felt.

e. From this point, turn the adjusting screw inward exactly two (2) more turns. This completes the adjustment. Install the welsh plug, furnished with the throttle body, over the adjusting screw and stake in place to conceal the screw.

f. Proceed with the reaming carburetor adjustments.

73. Air Horn Assembly

1. Install the following, if removed: choke shaft, choke valve and two attaching screws, air valve lockout lever and roll pin. Check for free operation.

(NOTE: The choke valve screws have a special sealing compound to hold them in place. If removed, they should be lightly staked after tightening.)

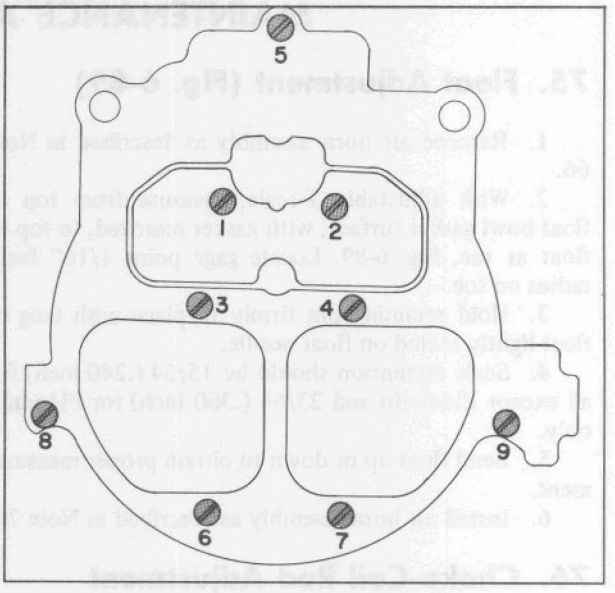


Fig. 6-88 Air Horn Screws Tightening Sequence

74. Air Horn to Bowl Assembly

1. Install vacuum break rod into vacuum break diaphragm plunger.

2. Insert vacuum break rod in slot of air valve shaft and twist air horn into position.

3. Lower air horn assembly to bowl carefully, positioning vent tubes and accelerating well tubes through air horn gasket.

4. Install two long air horn screws, four short screws, one intermediate length screw and two countersunk screws in primary venturi area. Special light colored screw is installed in position #3, Fig. 6-88.

5. Connect choke rod in lower choke lever and retain in upper lever with horeshoe clip.

(NOTE: Be sure choke rod is located under lock-out tang before installing clip.)

6. Install air valve lock-out guard under intermediate length screw (#4 in Fig. 6-88) and secure with self-tapping screw. To prevent binding of choke valve or air valve due to distortion of air horn, tighten all screws evenly, using sequence shown in Fig. 6-88.

7. Connect accelerator pump lever to upper end of pump rod and position pump lever in boss on air horn. Using a sharp bladed screwdriver, push roll pin back through lever until flush with boss. If roll pin is damaged, install new pin from front.

8. Install secondary metering rods into secondary metering rod hanger (upper ends or rod point towards each other). Install secondary metering rod hanger onto air valve cam follower. Install remaining screw and tighten securely. Work air valves up and down several times to make sure they are free in all positions.

MAINTENANCE ADJUSTMENTS ON CAR

75. Float Adjustment (Fig. 6-89)

1. Remove air horn assembly as described in Note 66.
2. With adjustable T-scale, measure from top of float bowl gasket surface, with gasket removed, to top of float at toe, Fig. 6-89. Locate gage point 1/16" from radius on toe.
3. Hold retaining pin firmly in place with tang of float lightly seated on float needle.
4. Scale dimension should be 15/64 (.240 inch) for all except Eldorado and 23/64 (.360 inch) for Eldorado only.
5. Bend float up or down to obtain proper measurement.
6. Install air horn assembly as described in Note 74.

76. Choke-Coil Rod Adjustment (On Car) (Fig. 6-90)

1. Remove choke assembly from manifold to disengage choke coil rod from vacuum break lever.
2. Reinstall choke coil assembly but do not install choke coil rod into hole in vacuum break lever.
3. With choke valve completely closed, fast idle cam in cold start position and vacuum break lever in maximum upward position, pull choke coil rod upward to end of travel against stop in choke coil housing. Upper end of rod should be positioned in gaging notch as shown in Fig. 6-90.
4. Bend choke-coil rod to adjust for position in proper gaging-notch.
5. Remove choke coil assembly from manifold. Reinstall by putting upper end of choke coil rod into hole in vacuum break lever and tighten coil assembly to manifold.

(NOTE: The "L" gauging notch is for a one notch leaner setting and the "R" gauging notch is for a one notch richer setting.)

77. Idle Mixture and Speed Adjustments (On Car)

a. Mixture Adjustment

The following procedure should not be considered

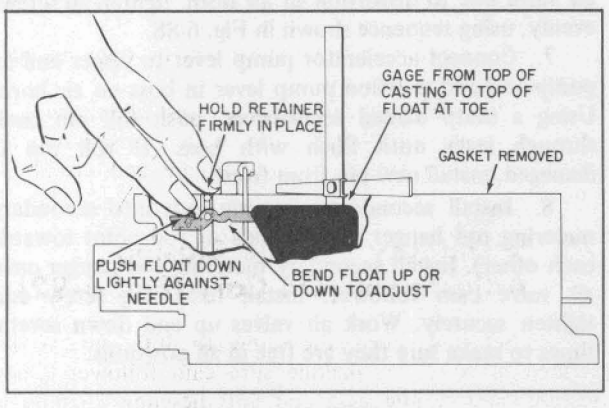


Fig. 6-89 Float Level Adjustment

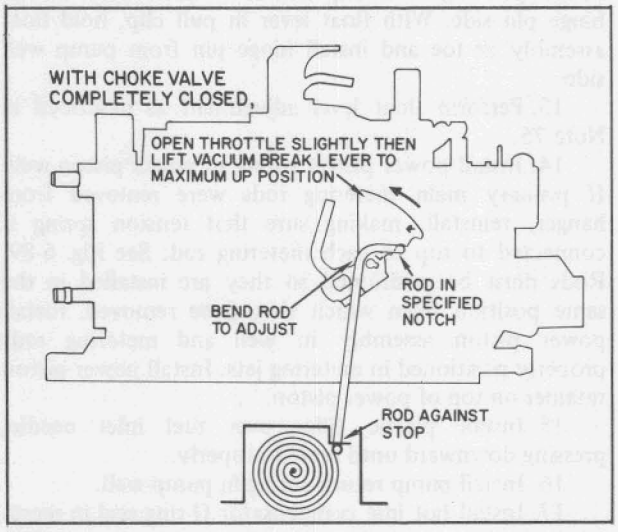


Fig. 6-90 Choke Coil Rod Adjustment

part of a normal tuneup. Idle mixture screws are equipped with limiter caps to prevent their being adjusted. Idle mixture limiter caps should not be removed unless it is necessary to replace the idle mixture needles or clean the idle passages. If mixture needles are replaced, the following procedure must be performed.

(NOTE: Before idle mixture adjustment is made, distributor vacuum advance hose must be disconnected at the distributor and plugged to eliminate the possibility of advancing the timing and increasing engine rpm.)

1. Disconnect parking brake vacuum hose at vacuum release cylinder and plug hose. Disconnect air leveling compressor hose at air cleaner and plug hose. Remove air cleaner but keep vacuum hoses connected.

(NOTE: Hoses must be disconnected at these locations to include any calibrated leakage in balance of system.)

2. Connect tachometer to engine, set parking brake securely and block wheels. Place transmission selector lever in Neutral.
3. Mixture screws should be out approximately 6 turns. Start and warm engine to normal operating temperature. Be sure that choke is fully off and that carburetor is on slow idle with primary and secondary throttle valves closed.
4. Place transmission selector lever in either "DR" position and turn A/C off.
5. Hot idle compensator must be closed when adjustment is made. This can be done by pressing compensator pin with eraser on end of pencil. Compensator pin is located in the air horn at the front mounting screw on the choke side. (697 and 698 A/C cars only)
6. Set idle speed to 620 rpm by adjusting anti-dieseling solenoid. Lock solenoid in place with sheet metal jam nut, Fig. 6-95.
7. Using Extension Hex- head Driver, J-22646, turn one idle mixture adjustment screw clockwise.

8. Turn screw until speed falls off 10 rpm.
9. Repeat steps 7 and 8 with other idle mixture adjusting screw. Idle mixture and speed adjustment is now complete. Idle speed should be 600 rpm. Install new red mixture screw limiter caps.
10. Shut off engine and remove tachometer.
11. Connect parking brake vacuum line.
12. Connect distributor vacuum line.
13. Install air cleaner.

b. Idle Speed Adjustment

Normal engine idle speed is no longer adjusted with the commonly used idle speed screw as in past years but with an anti-dieseling solenoid located where the dashpot was previously. To make an idle speed adjustment the car must be running; this energizes the solenoid and permits the solenoid plunger to move out.

The throttle must be opened slightly to allow the plunger to move out completely and then returned to idle position against the extended solenoid plunger before an idle speed adjustment can be made.

When the ignition is turned off the solenoid plunger retracts and the throttle lever comes to rest against the low speed idle adjusting screw.

The solenoid is not strong enough to open the throttle when energized, but if the throttle is opened slightly to allow the plunger to move out completely then the plunger will keep the throttle open at the adjusted idle speed.

(NOTE: Before low idle speed adjustment is made, distributor vacuum advance hose must be disconnected at the distributor and plugged to eliminate the possibility of advancing the timing and increasing engine rpm. Hose must be disconnected at this location to include any calibrated leakage in balance of system.)

Mixture adjustment must be correct before idle speed setting can be made.

1. Disconnect parking brake hose at vacuum release cylinder and plug hose. Set parking brake and block wheels. Disconnect air leveling compressor hose at air cleaner and plug hose.
2. Remove air cleaner (keep vacuum hoses connected), connect tachometer, start and warm-up engine to operating temperature in park. Choke should be fully off and throttle completely off the fast idle cam.
3. Place transmission selector lever in drive, turn air conditioning off and disconnect wire to anti-dieseling solenoid. Plunger should be retracted and not hold throttle open.
4. Hot idle compensator must be closed when adjustment is made. This can be done by pressing compensator pin with eraser on end of pencil. Compensator pin is located in the air horn at the front mounting screw on the choke side. (697 and 698 A/C cars only) Back off low speed idle adjusting screw.
5. Adjust idle speed screw on carburetor to give 350-400 rpm.
6. Reconnect solenoid wire, crack throttle slightly to extend plunger fully. Turn solenoid to adjust fore and aft position to provide a 600 rpm idle in drive with A/C off.

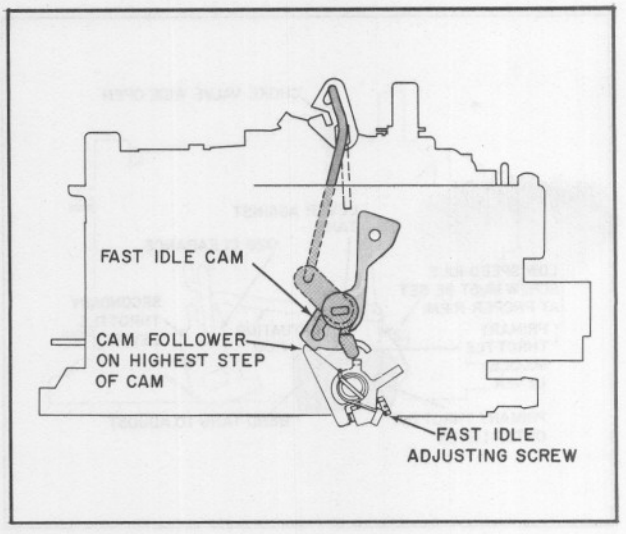


Fig. 6-91 Fast Idle Adjustment

7. Tighten lock nut and shut off engine. Remove tachometer.
8. Reconnect all disconnected hoses. Install air cleaner.

78. Fast Idle Adjustment (On Car) (Fig. 6-91)

In the 1971 model a fast idle spark vacuum by-pass system is used whereby spark vacuum from the carburetor by-passes the TCS solenoid and advances the distributor in park and neutral only. The spark vacuum was routed through the neutral safety switch.

In the 1972 model there is no spark advance during fast idle because the vacuum solenoid in series with the speed control switch prevents carburetor-spark vacuum from reaching the distributor at any time the car speed is below 33 ± 2 miles per hour.

(NOTE: Preceding idle adjustments must be made first. Automatic Climate Control should be in "Off" position on cars so equipped.)

1. Start engine and allow engine and transmission to reach operating temperature; choke should be fully open. Be sure parking brake is applied.
2. Shut off engine and remove air cleaner.
3. Open throttle slightly. Set fast idle cam follower on highest step of cam, Fig. 6-91.
4. Start engine. Choke valve will be open because engine is fully warmed up.
5. Observe idle speed and adjust fast idle screw, Fig. 6-91, to give 1900-1950 rpm with transmission in Neutral. Return engine to normal idle and install air cleaner.

79. Secondary Throttle Closing Adjustment (On Car) (Fig. 6-92)

1. Set low speed idle screw to 400 rpm, as described in Note 77, making sure cam follower is not resting on fast idle cam and anti-dieseling solenoid is disconnected.

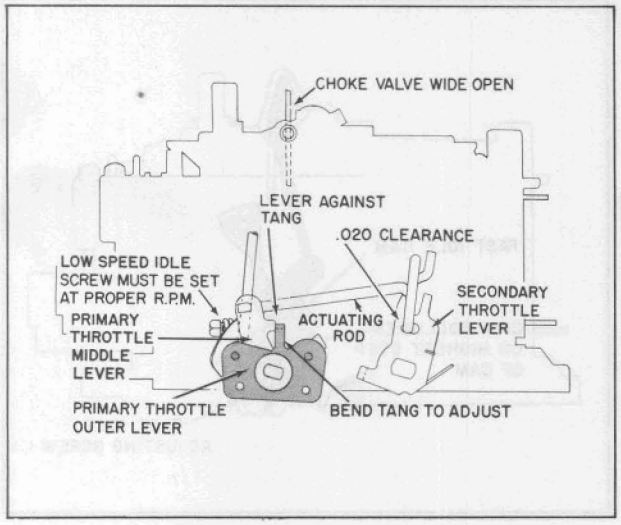


Fig. 6-92 Secondary Throttle Adjustment

2. There should be .020 clearance between actuating rod and front of slot in secondary throttle lever as shown in Fig. 6-92, when primary throttle middle lever is against tang of primary throttle outer lever.

3. If adjustment is correct, replace air cleaner.

4. If adjustment is necessary, remove transmission downshift switch by removing two screws from the dashpot bracket.

(NOTE: Secondary throttle opening adjustment (Note 90) must be made before attempting this adjustment.)

5. Disconnect throttle return spring and throttle rod or cable at throttle adapter plate.

6. Remove cross head recess screws holding throttle adapter plate to primary throttle outer lever, and remove throttle adapter plate.

7. Bend tang of primary throttle outer lever as necessary to adjust.

8. Attach throttle adapter place to primary throttle outer lever.

9. Connect throttle return spring(s) and throttle rod or cable at throttle adapter plate.

10. Install transmission downshift switch assembly and adjust as described in Section 7, Note 5b.

11. Connect anti-dieseling solenoid.

12. Install air cleaner.

80. Throttle Cable Adjustment (Except Eldorado)

1. Remove air cleaner.

2. Check linkage for free movement in all positions, and check to see that return spring fully closes the throttle.

3. Remove retainer that holds end of throttle cable in relay lever, and remove from relay lever.

4. On cars equipped with Cruise Control, detach Cruise Control clip at throttle lever and remove chain from throttle pivot.

5. While a helper presses accelerator pedal against floor mat, hold carburetor throttle lever in full throttle (wide open) position. Make sure choke valve is wide open.

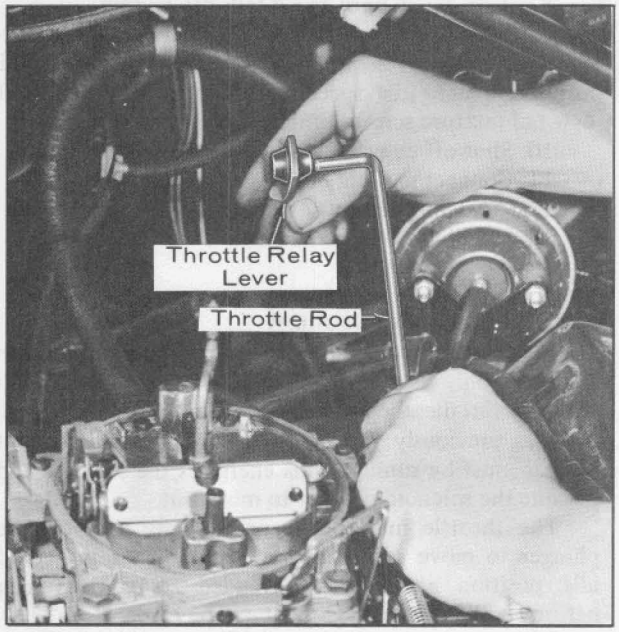


Fig. 6-93 Throttle Rod Adjustment—Except 693

6. Turn throttle cable end in either direction as necessary to allow free entry into relay lever, Fig. 6-93.

7. With accelerator pedal released, reinstall retainer on throttle pin on relay lever.

8. Recheck for fully closed throttle. With accelerator pedal pressed again to floor mat, recheck throttle for wide open position.

9. On cars equipped with Cruise Control, install Cruise Control linkage and secure with clip.

81. Throttle Cable Adjustment (693 Eldorado)

1. Remove air cleaner.

2. Check cable linkage for free movement in all positions, and check to see that return spring fully closes throttle.

3. Disconnect cable retaining clip at throttle adapter plate and remove cable from adapter plate.

4. While a helper presses accelerator pedal against floor mat, hold carburetor throttle lever in full throttle (wide open) position. Make sure choke valve is wide open.

5. If cable fitting does not line up exactly with its connecting pin on throttle adapter plate, loosen two nuts at cable mounting plate on left rear of carburetor, and position cable backward or forward to allow exact alignment into throttle adapter plate hole, Fig. 6-94.

6. Tighten cable mounting screws on mounting plate.

7. With accelerator again pressed to floor mat, recheck throttle for wide open position. Recheck for fully closed throttle.

8. Replace air cleaner.

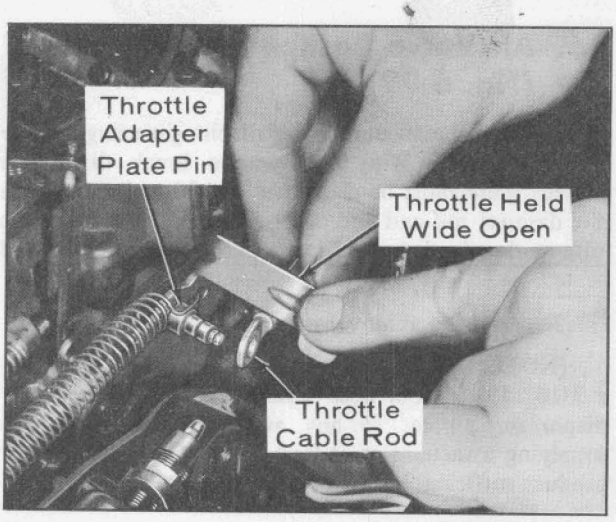


Fig. 6-94 Throttle Rod Adjustment—693 Only

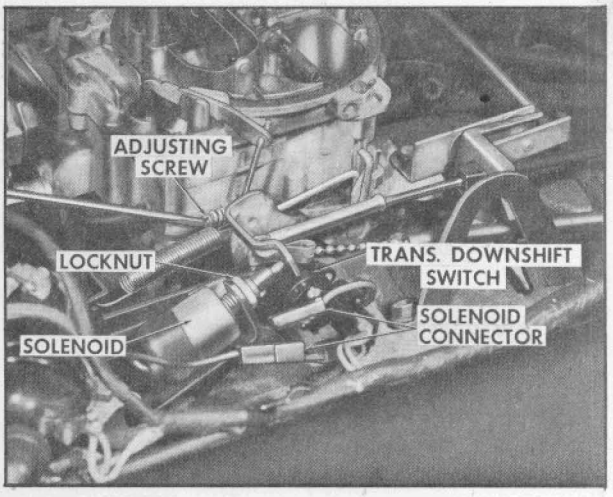


Fig. 6-95 Adjusting Anti-Dieseling Solenoid

82. Anti-Dieseling Solenoid (Fig. 6-95)

a. Removal

1. Remove air cleaner.
2. Disconnect solenoid from harness at connector.
3. Remove locknut securing solenoid to bracket, Fig. 6-95, and unscrew solenoid from bracket.

b. Installation

1. Install solenoid to bracket by threading through bracket from front of engine, Fig. 6-95.
2. Install locknut on solenoid shaft finger tight.
3. Adjust solenoid as described in 77b.
4. Tighten locknut and install air cleaner.

MAJOR OVERHAUL ADJUSTMENTS

83. Bench Fast Idle Adjustment (Fig. 6-96)

1. With primary throttle valves completely closed and cam follower over high step of fast idle cam, turn fast idle screw in one and one-half turns after screw makes contact on lever, Fig. 6-96. Final adjustment must be made on car.

84. Pump Rod Adjustment (Fig. 6-97)

1. With slow speed idle adjusting screw backed out of contact, throttle valves completely closed and pump rod in outer hole of pump lever, measure from top of choke valve wall, next to vent stack, to top of pump stem with adjustable T-scale.

2. Dimension should be 11/32". Bend pump lever at outer end with an adjustable wrench, Fig. 6-97, to adjust. The lever can be bent more easily if a screwdriver is used between the lever and casting as a support when bending lever.

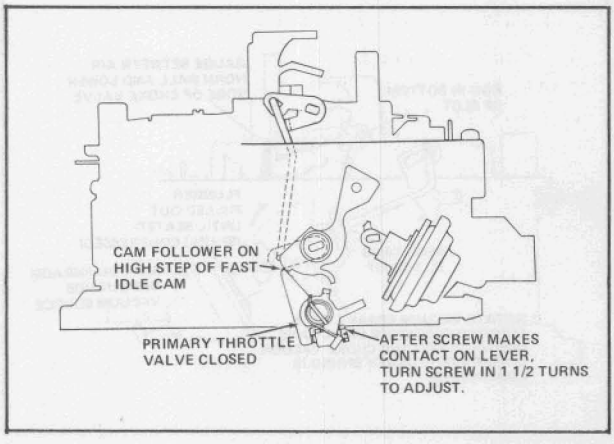


Fig. 6-96 Fast Idle Adjustment—Bench

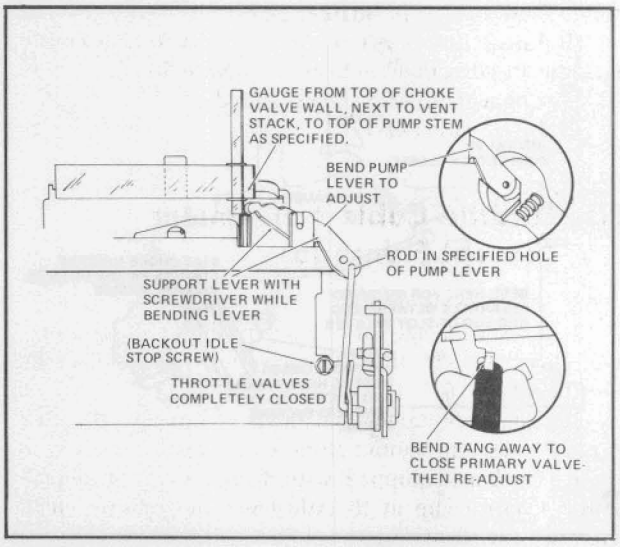


Fig. 6-97 Accelerator Pump Adjustment

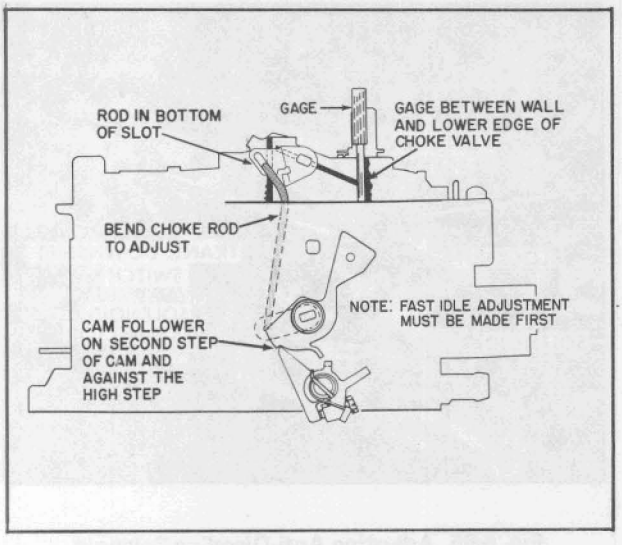


Fig. 6-98 Choke Rod Adjustment

(NOTE: Be sure secondary actuating rod is not keeping the primary throttle valves from closing. If the primary throttle valves do not completely close, bend the secondary closing tang out of position and then re-adjust after pump adjustment.)

85. Choke Rod Adjustment (Fig. 6-98)

1. Bench fast idle adjustment, Note 83, must be made before choke rod adjustment is made.
2. With bench fast idle adjustment made, cam follower on second step of fast idle cam and against high step of cam, rotate the choke valve toward the closed position by pushing up on vacuum break lever.
3. With choke rod at bottom of choke lever slot, dimension between lower edge of choke valve and air horn should be .090 inch.
4. Bend choke rod, Fig. 6-98, to adjust.

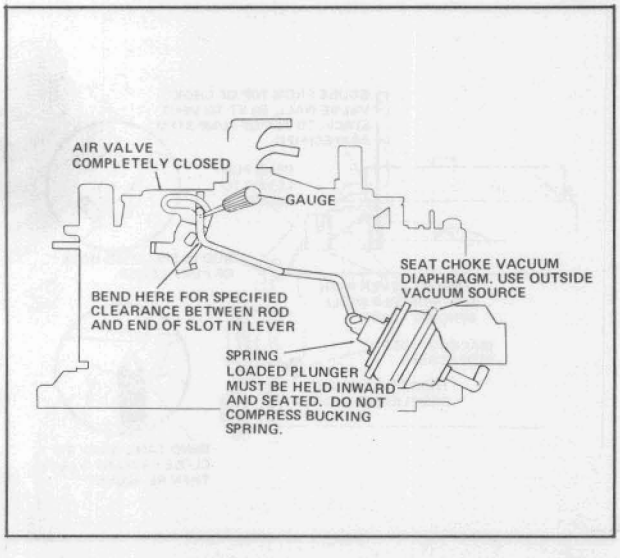


Fig. 6-99 Air Valve Adjustment

86. Air Valve Dashpot Adjustment (Fig. 6-99)

1. Seat the vacuum break diaphragm using outside vacuum source. With the vacuum break diaphragm seated, there must be clearance of .030 inches between the dashpot rod and end of slot in air valve lever. Make sure spring loaded diaphragm plunger is fully in and seated.

2. Bend rod at air valve end, Fig. 6-99, to adjust.

(NOTE: The diaphragm may be seated by attaching a 3/16" I.D. rubber hose from the vacuum break unit diaphragm nipple, to any available external source supplying a vacuum of at least 6" hg. Oral vacuum will produce sufficient vacuum to seat the diaphragm.)

87. Vacuum Break Adjustment (Fig. 6-100)

(NOTE: Use of an external vacuum source (vacuum pump, oral vacuum, etc.) is required when adjusting vacuum break assemblies.)

1. Bench fast idle adjustment, Note 83, choke rod adjustment, Note 85, and air valve dashpot adjustment, Note 86, must be made before this adjustment.
2. Open throttle valve and set fast idle cam on the high step.
3. Install a rubber band to the vacuum break lever and some portion of the air horn near the secondary air valve so that the tang of the vacuum break lever will be pulled rearward, contacting the vacuum break rod when vacuum is applied to the vacuum break unit.

(NOTE: This procedure is necessary to make certain that only the diaphragm link, Fig. 6-100, to which the vacuum break rod is attached is in the extended position (toward rear of engine) while the diaphragm is in the fully seated position when the adjustment is being made.)

4. Disconnect rubber tee from vacuum break unit.
5. Connect a short (15" - 20") piece of 3/16" I.D. rubber hose to the nipple on vacuum break unit.
6. Apply vacuum from an external source to the

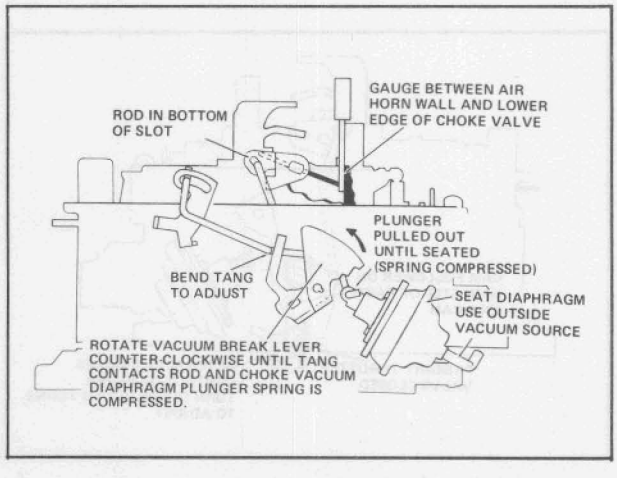


Fig. 6-100 Vacuum Break Adjustment

nipple of the vacuum break unit until the diaphragm is seated and the diaphragm link is in the extended position. Maintain vacuum to hold in this position by clamping off the hose.

7. Dimension between the front wall of the air horn and lower edge of choke valve should be .110 inch. All play should be taken out of choke valve by lightly pressing valve toward its open position.

(NOTE: Choke rod should be at the bottom of the choke lever.)

8. Bend vacuum break lever tang, Fig. 6-100, to adjust.

88. Unloader Adjustment (Fig. 6-101)

1. With choke valve held toward closed position by lifting up on vacuum break lever, open primary throttle to wide open position.

2. With valves in this position, take up linkage slack toward open position of valve. Dimension between lower edge of choke valve and air horn wall should be .312 inch.

3. Bend tang on fast idle adjusting lever, Fig. 6-101, to adjust.

89. Air Valve Adjustments

a. Opening Clearance

(NOTE: Fast idle (off car) and choke rod adjustments must be made prior to this adjustment.)

1. Remove two screws securing lockout guard to air horn and remove air valve lockout guard.

2. With choke valve wide open, apply sufficient downward force to the vacuum break lever to move choke rod to top of slot in choke lever.

3. Move air valve slightly in direction of open valve.

4. Bend upper end of air valve lockout lever tang, Fig. 6-102, if necessary, to give an opening of .015 inch between lockout tang and front edge of air valve.

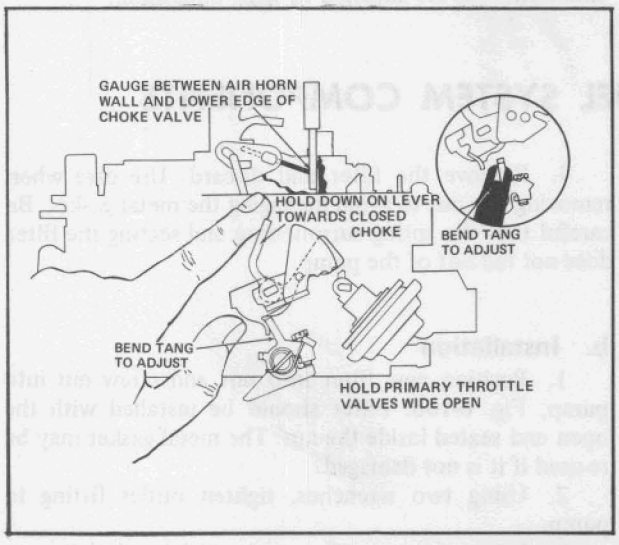


Fig. 6-101 Unloader Adjustment

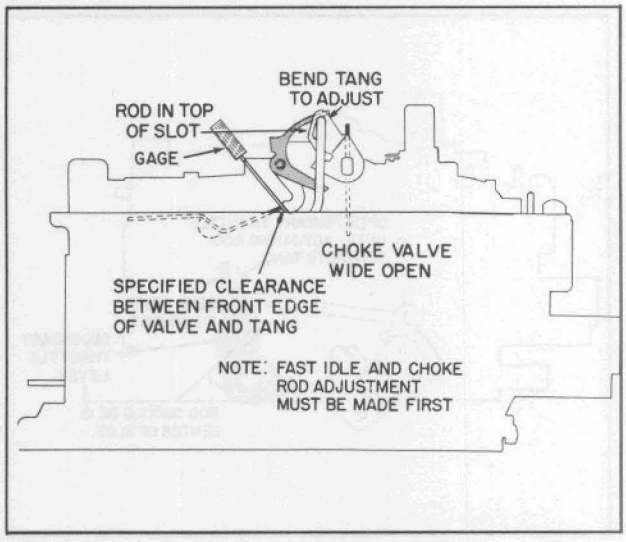


Fig. 6-102 Air Valve Lockout Adjustment

5. Install air valve lockout guard and secure with two screws.

b. Lockout

1. With the opening clearance adjustments made open choke valve to its wide open position by applying an opening force to "up" side of choke valve.

2. Open throttle slightly and set fast idle adjusting lever on highest step of fast idle cam. Making sure choke rod is in bottom of slot, by applying upward force to vacuum break lever, air valve lockout tang should allow only 6°-10° of air valve opening. During choke-on conditions, (warm-up) the air valve will open only 6°-10° even if throttle is wide open. This angle is not adjustable but is built into the assembly.

c. Spring Wind-Up

(NOTE: This adjustment must be made only when replacing air valve. During normal overhaul do not remove air valve.)

1. Loosen allen socket head lockscrew, Fig. 6-103,

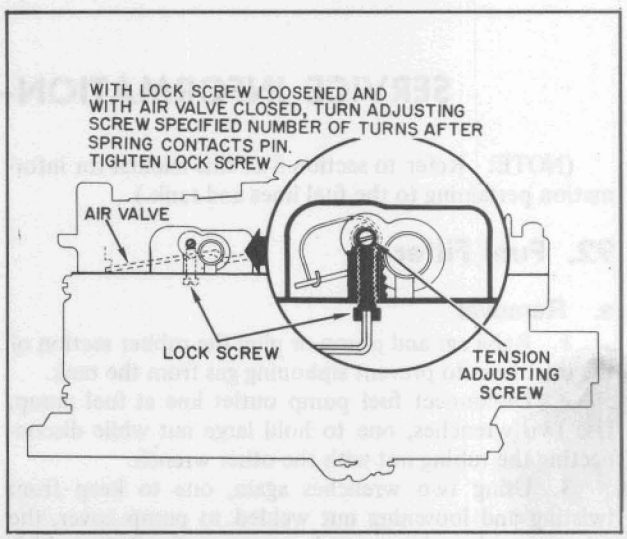


Fig. 6-103 Air Valve Spring Wind-Up Adjustment

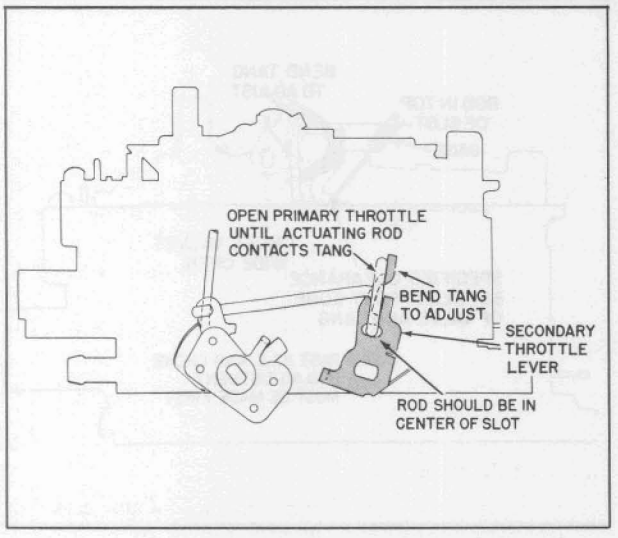


Fig. 6-104 Secondary Throttle Adjustment

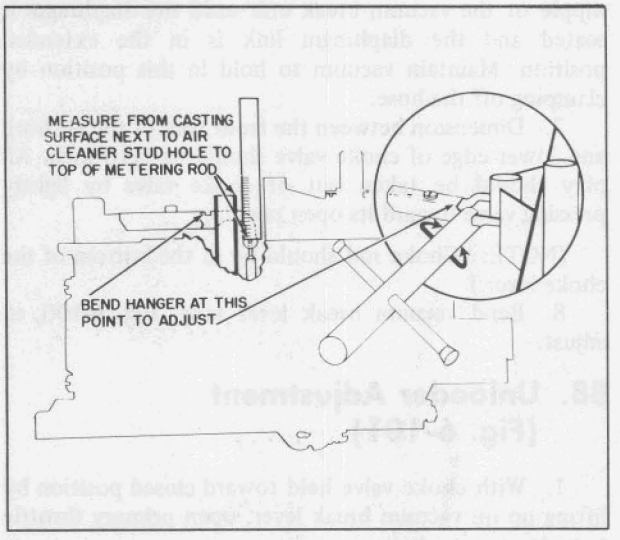


Fig. 6-105 Secondary Metering Rod Adjustment

and turn adjusting screw counterclockwise to remove all spring tension.

2. With air valve closed, turn adjusting screw clockwise 1/2 turn after torsion spring contacts pin on shaft. Holding adjusting screw in this position, tighten lockscrew.

90. Secondary Throttle Opening Adjustment (Fig. 6-104)

1. Open primary throttle valves until actuating rod contacts tang on secondary throttle lever. With valves in this position, bottom of rod should be in center of secondary throttle lever slot.

2. Bend tang on secondary throttle lever, Fig. 6-104, if necessary to adjust.

91. Secondary Metering Rod Adjustment (Fig. 6-105)

(NOTE: The metering rod hanger is not adjustable. Hangers are selectively matched to each carburetor and letter stamped. Unless the hanger has been damaged no change in hanger setting is necessary. If the hanger has been damaged, an adjustable hanger (holding kit) must be obtained from your servicing Parts Distribution Center and adjusted as described in this note.)

1. To check secondary metering rod adjustment, measure from top of metering rod to top of air horn casting next to air cleaner stud hole, as shown in Fig. 6-105. This dimension should be .840 or approximately 27/32 for all carburetors.

(NOTE: Be sure to measure metering rod at the point where it enters the hanger. Do not use the bent portion of the rod for this measurement. Air valve must be closed when measurement is taken.)

2. If adjustment is necessary, bend metering rod hanger with pliers at point shown in Fig. 6-105. Make sure both rods are adjusted to same dimension.

SERVICE INFORMATION—FUEL SYSTEM COMPONENTS

(NOTE: Refer to section 8 of this manual for information pertaining to the fuel lines and tank.)

92. Fuel Filter

a. Removal

1. Raise car and clamp or plug the rubber section of the inlet hose to prevent siphoning gas from the tank.

2. Disconnect fuel pump outlet line at fuel pump. Use two wrenches, one to hold large nut while disconnecting the tubing nut with the other wrench.

3. Using two wrenches again, one to keep from twisting and loosening nut welded to pump cover, the other wrench to loosen and remove outlet fitting which retains the filter.

4. Remove the filter and discard. Use care when removing the nut to avoid damaging the metal gasket. Be careful that the spring surrounding and seating the filter does not fall out of the pump.

b. Installation

1. Position new filter into nut and screw nut into pump, Fig. 6-106. Filter should be installed with the open end seated inside the nut. The metal gasket may be re-used if it is not damaged.

2. Using two wrenches, tighten outlet fitting to pump.

3. Using two wrenches again, tighten fuel line to outlet fitting. Remove clamp from hose.

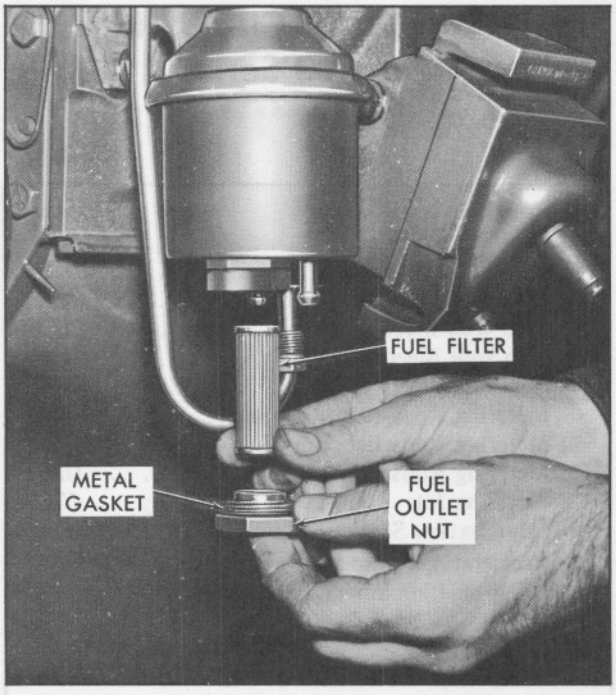


Fig. 6-106 Installing Fuel Filter

4. Wipe all gasoline that may have spilled and ventilate area before starting engine.

5. Start engine and check for leaks; correct leaks as necessary.

93. Fuel Pump

a. Removal

1. Raise car.

2. Disconnect fuel line from tank (fuel pump inlet) at fuel pump and plug line. Hold a cloth around pump connections to absorb any fuel that leaks out.

3. Remove vapor return hose from fitting on fuel pump and plug hose.

4. Disconnect fuel-pump-to-carburetor line (fuel pump outlet) and position out of way.

5. Remove mounting screws from upper and lower flanges.

6. Tipping pump upward, pull pump straight outward and remove from car.

b. Installation

1. Clean mounting flange and place a new gasket in position. Use cement to hold gasket in position.

2. Position pump on engine and secure with two washer head screws.

3. Connect fuel line from carburetor to outlet fitting on pump and tighten securely.

4. Unplug fuel line from fuel tank, attach line to pump inlet and secure with clamp.

5. Install vapor return hose on fitting in fuel pump and secure with clamp.

6. Lower car and run engine to check for leaks in the pump area.

QUADRAJET CARBURETOR SPECIFICATIONS
MODEL 4MV

Throttle Bore		Air Valve Spring Windup Adjustment	9/16 turn
Primary	1-3/8"	Choke Rod Adjustment	.090"
Secondary	2-1/4"	(Setting)	Index
Main Venturi		Vacuum Break Adjustment	.140"
Primary	1.093"	Pump Rod Adjustment (11/32")	.344"
Secondary	.625"	Outer hole capacity 7.0 to 10.0 cc per 10 strokes	
Tertiary	.281"	Unloader Adjustment	.310"
Float Level Adjustment		Fast Idle Setting - RPM	
Except Eldorado 1/4" (Approx.)	.240"	(A/C off)	1900 - 1950
Eldorado Only 23/64	.360"	Curb Idle - RPM (In drive, A/C off)	600
Air Valve Dashpot Adjustment	.030"	Low Speed Idle - RPM	
Air Valve Lockout Adjustment	.015"	(In drive, A/C off)	400
Secondary Metering Rod Hanger			
Service Hanger Only	.840"		
Secondary Throttle Closing Adjustment	.020"		

METERING SPECIFICATIONS For Series 680, 681, 682, 683, 697 and 698

	Inch
Primary Side	
Idle Tubes	.036
Channel Restrictions	.052
Auxiliary Well Bleeds	.030
Side Well Bleeds	.050
Top Well Bleeds	.055
Side Idle Bleeds	.049
Metering Rods Identification	43B
Metering Rods Economy End	.043
Metering Rods Power End	.026
Metering Jets	69C
Idle Mixture Screws	2 turns
Accelerating Pump Jets	0.026"
Pull Over Enrichment–Discharge	0.032
Secondary Side	
Secondary Well Tubes	.036
Secondary Rods Identification	BC
Secondary Rod Wide Open Throttle Step	.041
Accelerating Well Feed Holes	.040
Accelerating Well Discharge Holes	.055

METERING SPECIFICATIONS For 693 Series

	Inch
Primary Side	
Idle Tubes	.036
Channel Restrictions	.055
Auxiliary Well Bleeds	.030
Side Well Bleeds	.050
Top Well Bleeds	.050
Side Idle Bleeds	.049
Metering Rods Identification	39B
Metering Rods Economy End	.039
Metering Rods Power End	.026
Metering Jets	67C
Idle Mixture Screws	2 turns
Accelerating Pump Jets	0.026"
Pull Over Enrichment–Discharge	.032
Secondary Side	
Secondary Well Tubes	.036
Secondary Rods Identification	CF
Secondary Rod Wide Open Throttle Step	.034
Accelerating Well Feed Holes	.040
Accelerating Well Discharge Holes	.055

FUEL PUMP SPECIFICATIONS

NOTE: Testing to be done with entire car at room temperature.

Fuel pressure at idle speed	5-1/4 to 6-1/2 psi
Fuel pump discharge per stroke at cranking speed	28 cc. Minimum
Fuel pump discharge in 17 strokes at cranking speed	1 pint Minimum

TORQUE SPECIFICATIONS

Material Number	Application	Thread Size	Torque
260-M	Carburetor to Intake Manifold Screw (Rear)	5/16-18	14 ft. lbs.
260-M	Carburetor to Intake Manifold Screw (Front)	5/16-18	10 ft. lbs.
280-M	Fuel Pump to Cylinder Block Screw	5/16-18	14 ft. lbs.

NOTE: Refer to back of manual, Page 16-1, for bolt and nut markings and steel classifications.

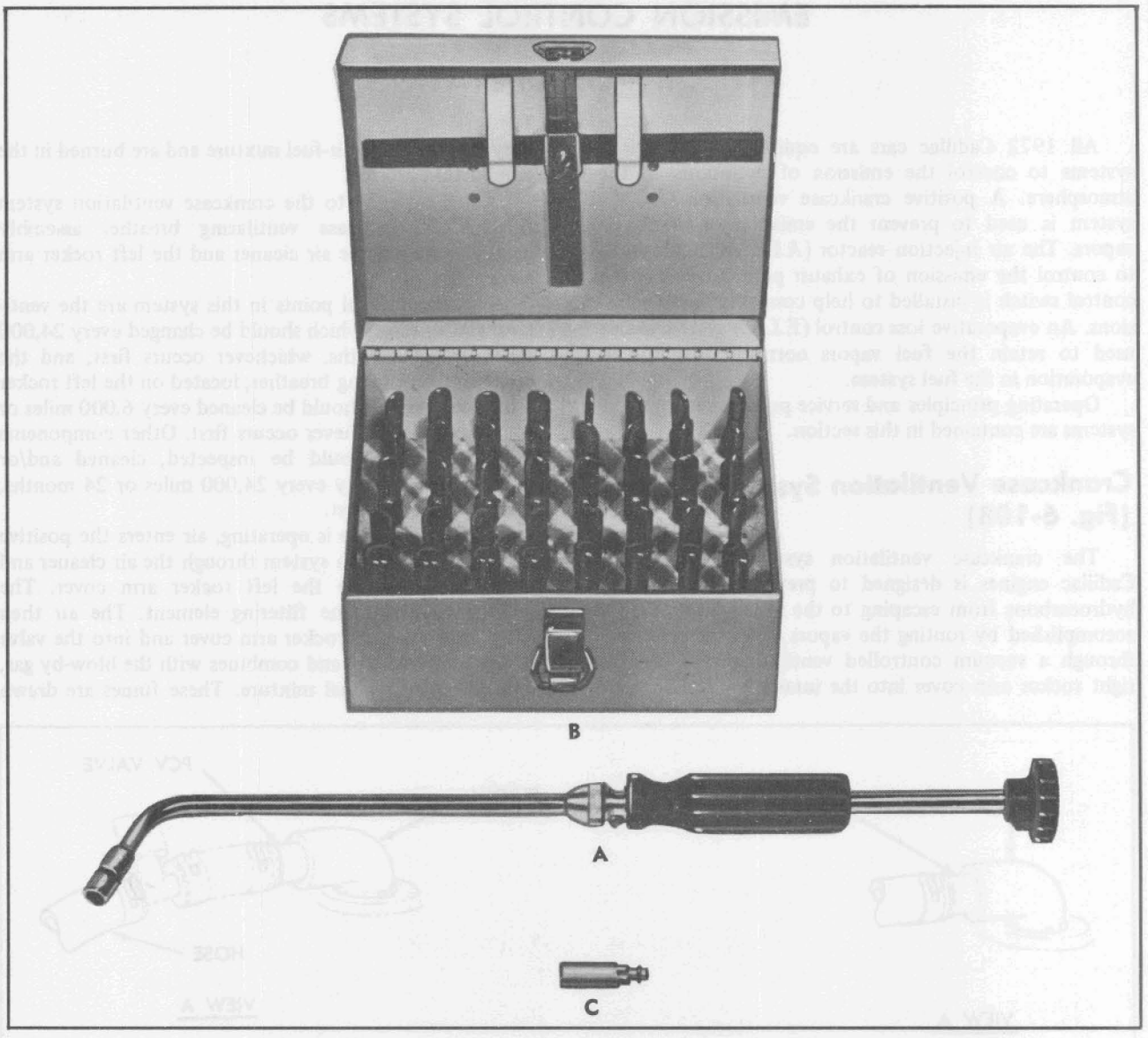


Fig. 6-107 Special Tools

Key	Tool Number	Name
A	J-22646	1/4" Hex-Head Extension Driver
B	J-9789-01	Universal Gage Set
C	J-22769	Seat Remover

EMISSION CONTROL SYSTEMS

THEORY OF OPERATION

All 1972 Cadillac cars are equipped with various systems to control the emission of pollutants to the atmosphere. A positive crankcase ventilation (P.C.V.) system is used to prevent the emission of crankcase vapors. The air injection reactor (A.I.R.) system works to control the emission of exhaust pollutants. A speed control switch is installed to help control exhaust emissions. An evaporative loss control (E.L.C.) system is also used to retain the fuel vapors normally lost due to evaporation in the fuel system.

Operating principles and service procedures for these systems are contained in this section.

Crankcase Ventilation System (Fig. 6-108)

The crankcase ventilation system on all 1972 Cadillac engines is designed to prevent contaminating hydrocarbons from escaping to the atmosphere. This is accomplished by routing the vapors from the crankcase through a vacuum controlled ventilating valve on the right rocker arm cover into the intake manifold, where they mix with the air-fuel mixture and are burned in the combustion process.

Air is supplied to the crankcase ventilation system through a crankcase ventilating breather assembly located between the air cleaner and the left rocker arm cover.

The two critical points in this system are the ventilator (PCV) valve, which should be changed every 24,000 miles or 24 months, whichever occurs first, and the crankcase ventilating breather, located on the left rocker arm cover, which should be cleaned every 6,000 miles or four months, whichever occurs first. Other components of the system should be inspected, cleaned and/or replaced as necessary every 24,000 miles or 24 months, whichever occurs first.

When the engine is operating, air enters the positive crankcase ventilation system through the air cleaner and breather located on the left rocker arm cover. The breather contains the filtering element. The air then flows into the left rocker arm cover and into the valve lifter compartment, and combines with the blow-by gas, and unburned air-fuel mixture. These fumes are drawn

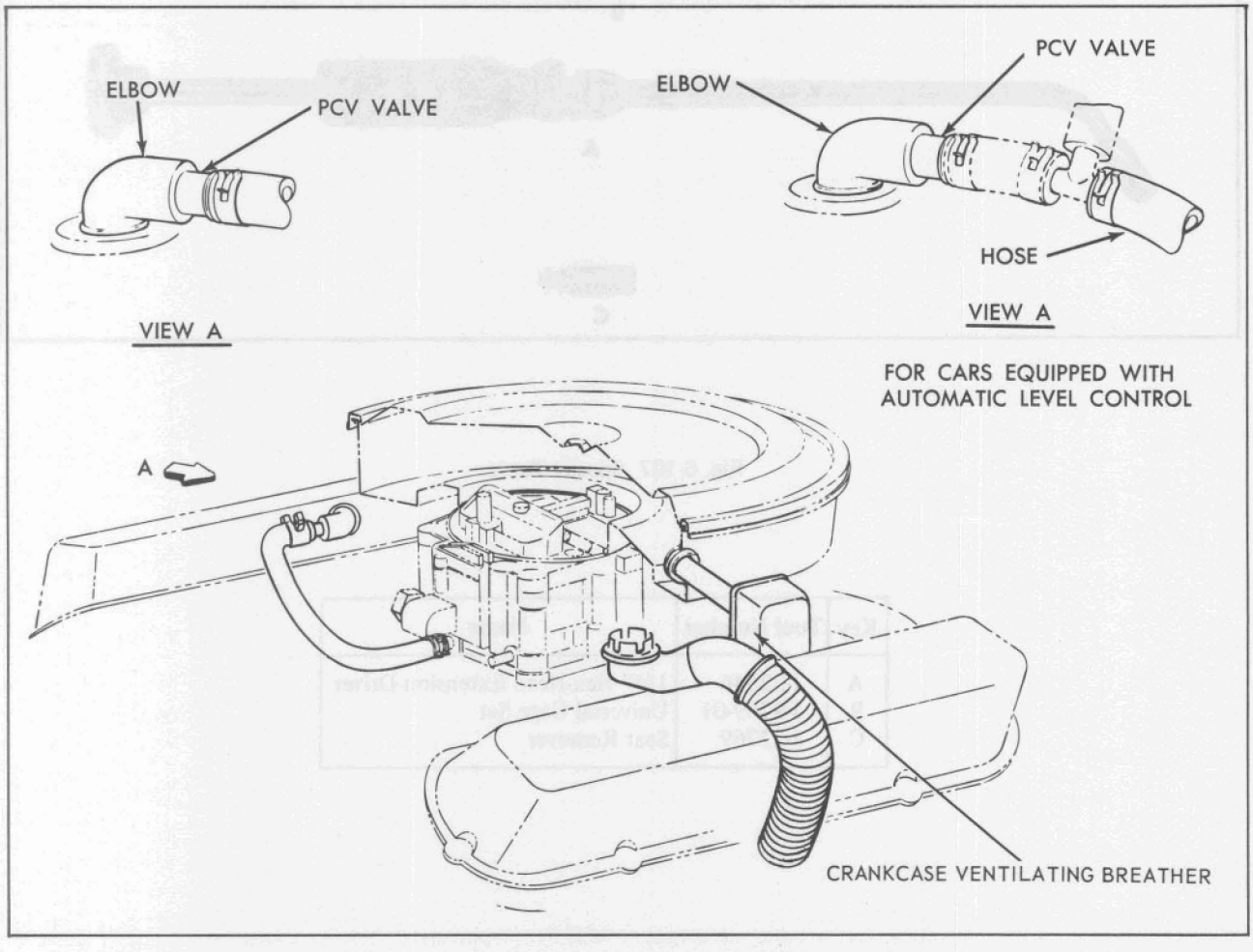


Fig. 6-108 Positive Crankcase Ventilation System

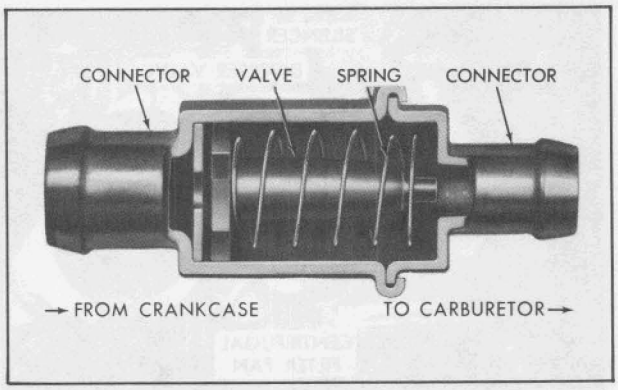


Fig. 6-109 P.C.V. Valve

through the right rocker arm cover and ventilation valve into the base of the carburetor and intake manifold, where they are mixed with the air-fuel mixture and burned.

The ventilator valve, Fig. 6-109, is constructed so that it is held closed by spring pressure when the engine is not running. This prevents an accumulation of hydrocarbon laden fumes from collecting in the intake manifold, which could result in hard starting.

As the engine is started, manifold vacuum pulls the valve open against the spring pressure and as long as there is engine vacuum, the valve floats, permitting crankcase fumes to enter the intake manifold. A baffle in the right rocker arm prevents oil from being drawn into the intake manifold through the ventilator valve.

In the event of an engine backfire through the intake manifold the ventilator valve shuts, preventing any flow through it. This action prevents the ignition of fumes in the crankcase.

During certain engine operations where more blow-by is created than the ventilator valve can handle, the excess amount is returned to the air cleaner and to the carburetor by way of the left rocker arm cover and breather assembly and burned in the engine, instead of being released into the atmosphere. The breather assembly acts as a separator to keep oil from being drawn into the air cleaner during this operation.

Air Injection Reactor System (A.I.R.)

The A.I.R. system, Fig. 6-110 and 6-112, is installed on all 1972 Cadillac cars. The Cadillac A.I.R. system reduces the amount of hydrocarbons and carbon monoxide in the exhaust gas by injecting air directly into the exhaust port of each cylinder and by controlling the temperature of the carburetor intake air. The air added to the hot exhaust gases causes further oxidation

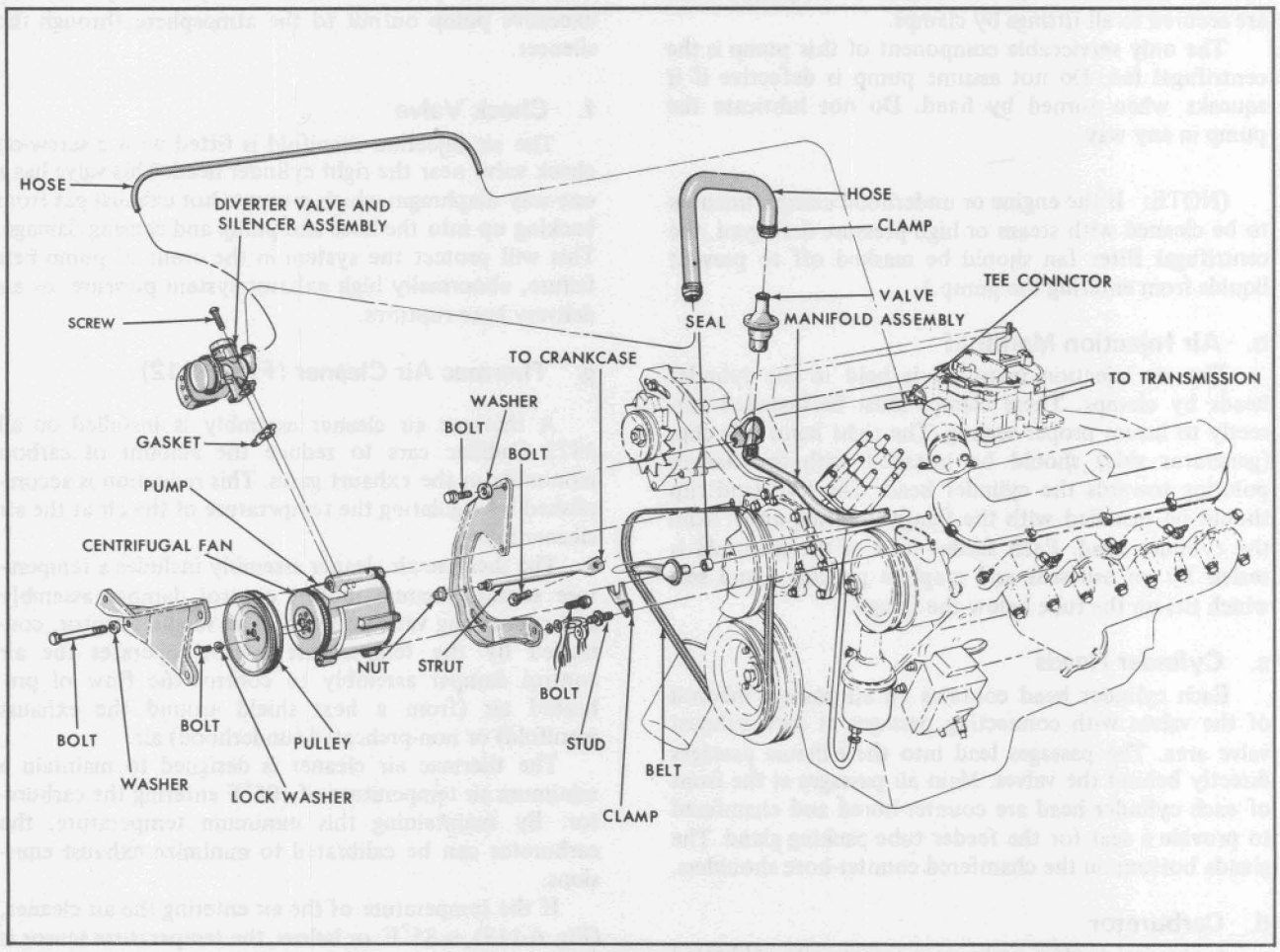


Fig. 6-110 Air Injection Reactor System

of the gases before they enter the exhaust pipe. By regulating the inlet air temperature, the carburetor may be calibrated to reduce exhaust emissions.

The A.I.R. system consists of a belt-driven pump located with the front accessory group, a formed rubber air hose, a metal tubing manifold between the cylinder heads, specially designed cylinder heads that incorporate air passages to the rear of each exhaust valve and a thermac air cleaner assembly. There is a diverter valve and silencer on the A.I.R. pump to control pressures within the system, and a check valve to protect the hoses and pump from hot gases.

Do not attempt to operate vehicle with drive belt disconnected.

a. Air Pump (Fig. 6-111)

The belt-driven air pump is located at the lower right front of the engine. The pump front mounting bracket is attached to the front of the engine. The pump rear mounting bracket is attached to the cylinder block. Power take-off for the pump is at the crankshaft pulley. Pump speed is 1.20 times crankshaft speed. Intake air passes through a centrifugal fan at the front of the pump, where foreign materials are separated from the air by centrifugal force. Air is delivered to the air injection manifold by a formed flexible hose of three-quarter inch inside diameter fitted to a three-quarter inch exhaust tube on the diverter valve at the side of the pump, hoses are secured to all fittings by clamps.

The only serviceable component of this pump is the centrifugal fan. Do not assume pump is defective if it squeaks when turned by hand. Do not lubricate the pump in any way.

(NOTE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked off to prevent liquids from entering the pump.)

b. Air Injection Manifold

The air injection manifold is held in the cylinder heads by clamps. These clamps must be installed correctly to insure proper sealing. The right hand side clip, (generator side) should be installed with the flanges pointing towards the cylinder head. The left hand clip should be installed with the flange pointing away from the cylinder head. Each feeder tube of the manifold is sealed by an asbestos and graphite packing gland seal which fits on the tube below the flange.

c. Cylinder Heads

Each cylinder head contains an air passage inboard of the valves with connecting passages at each exhaust valve area. The passages lead into the exhaust passages directly behind the valves. Main air passages at the front of each cylinder head are counter-bored and chamfered to provide a seat for the feeder tube packing gland. The glands bottom on the chamfered counter-bore shoulders.

d. Carburetor

A Quadrajet 4MV carburetor is specially calibrated for use on Cadillac cars. The idle mixture screws are

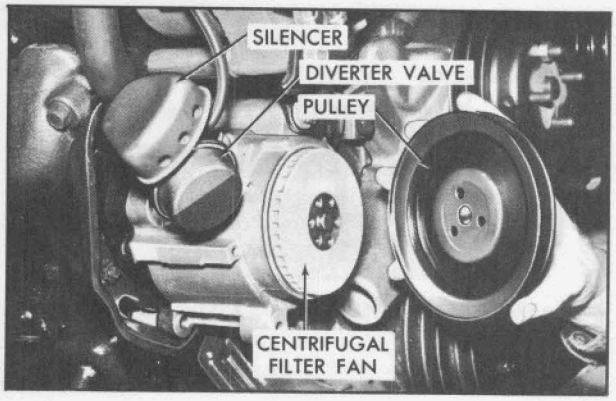


Fig. 6-111 A.I.R. Pump

computer adjusted and sealed at the factory to provide finer mixture control.

e. Diverter Valve (Fig. 6-111)

The diverter valve is attached to the side of the pump. It senses manifold vacuum through a three-sixteenths inch fitting at the carburetor. During sudden deceleration, vacuum increases causes the valve to open, allowing air from the air injection pump to pass through the valve and silencer to the atmosphere. Approximate duration of the valve openings is four seconds. This valve also controls pressure within the system by diverting excessive pump output to the atmosphere through the silencer.

f. Check Valve

The air injection manifold is fitted with a screw-on check valve near the right cylinder head. This valve has a one-way diaphragm which prevents hot exhaust gas from backing up into the hose and pump and causing damage. This will protect the system in the event of pump belt failure, abnormally high exhaust system pressure, or air delivery hose ruptures.

g. Thermac Air Cleaner (Fig. 6-112)

A thermac air cleaner assembly is installed on all 1972 Cadillac cars to reduce the amount of carbon monoxide in the exhaust gases. This reduction is accomplished by regulating the temperature of the air at the air cleaner inlet.

The thermac air cleaner assembly includes a temperature sensor, vacuum motor, control damper assembly and connecting vacuum hoses. The vacuum motor, controlled by the temperature sensor, operates the air control damper assembly to control the flow of preheated air (from a heat shield around the exhaust manifold) or non-preheated (underhood) air.

The thermac air cleaner is designed to maintain a minimum air temperature of 105°F entering the carburetor. By maintaining this minimum temperature, the carburetor can be calibrated to minimize exhaust emissions.

If the temperature of the air entering the air cleaner, (Fig. 6-113), is 85°F. or below, the temperature sensor is closed to allow engine vacuum to be directed to the vacuum motor closing the damper assembly to outside

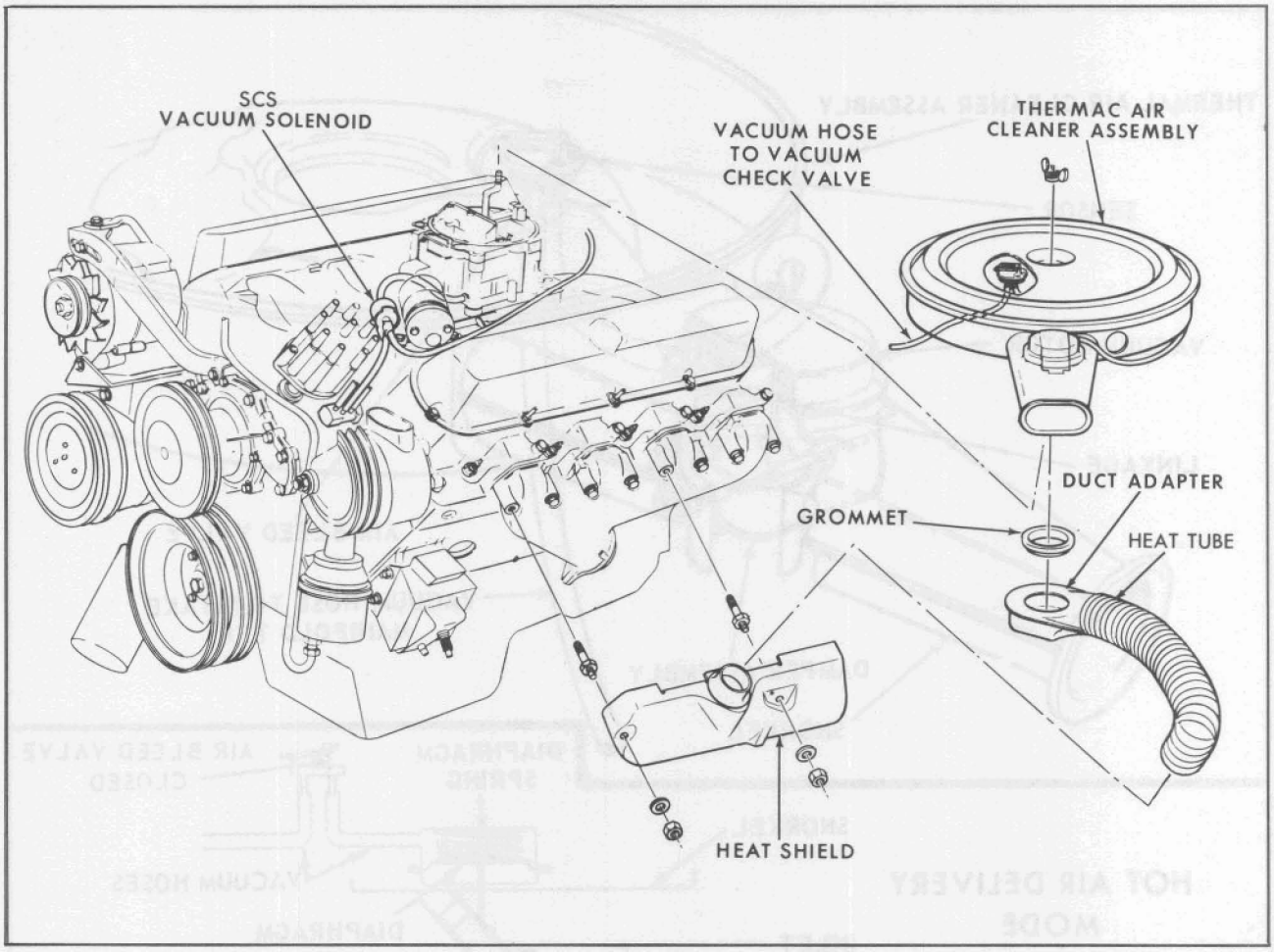


Fig. 6-112 Controlled Combustion System

air. With the damper closed, cool air will flow through the openings at the ends of the exhaust manifold heat shield where it is heated by the exhaust manifold. This pre-heated air then flows up through the heat tube to the air cleaner. This is the hot air delivery mode.

As the temperature inside the air cleaner reaches approximately 100°F, the sensor valve begins to open and bleed off vacuum from the vacuum motor. This allows the vacuum motor diaphragm spring to partially open the damper, allowing underhood air to be mixed with the heated air to keep the intake air temperature at approximately 100°F. Under full throttle conditions (less than 6-8" H.G.) the vacuum will no longer hold the valve open to hot air. Diaphragm spring pressure closes the hot air pipe allowing only underhood ("cool") air to enter the carburetor.

During a "no vacuum or engine off condition", the damper will be positioned to close heat tube.

Speed Control Switch (Fig. 6-114)

The 1972 Cadillac has a new distributor vacuum advance control called the Speed Control Switch, that replaces the transmission controlled spark previously used on 1971 model cars. This switch controls the spark advance at low speeds and is required to obtain the desired exhaust emissions. The S.C.S. sensor is mounted in the transmission integral with the speedometer driven gear on c-cars without track master. On c-cars with track master, the S.C.S. sensor is mounted on the frame side rail and connected in line with the speedometer cable. On Eldorados, with or without track master, the S.C.S. sensor installed on the speedometer driven gear in the transmission modulator housing.

The speed control switch is designed to help control exhaust emissions by shutting off vacuum to the distributor vacuum advance unit during speeds from 0 to 33 ± 2 mph. A vacuum solenoid, mounted near the ignition coil, controls the path of vacuum in response to this speed control switch. The speed control switch senses the speed and is activated at 33 ± 2 miles per hour. The contacts remain closed prior to 33 ± 2 miles per hour thus providing a complete circuit from the battery through the vacuum solenoid to the speed control switch which is grounded. The complete circuit activates the vacuum solenoid moving the valve against spring pressure eliminating vacuum advance to the distributor, thereby reducing exhaust emissions. In this position the advance unit is vented to atmosphere through the hose at the rear of the carburetor.

The above action is illustrated in Fig. 6-115, as the "no vacuum advance position." When car speed reaches 33 ± 2 miles per hour the contacts inside the speed

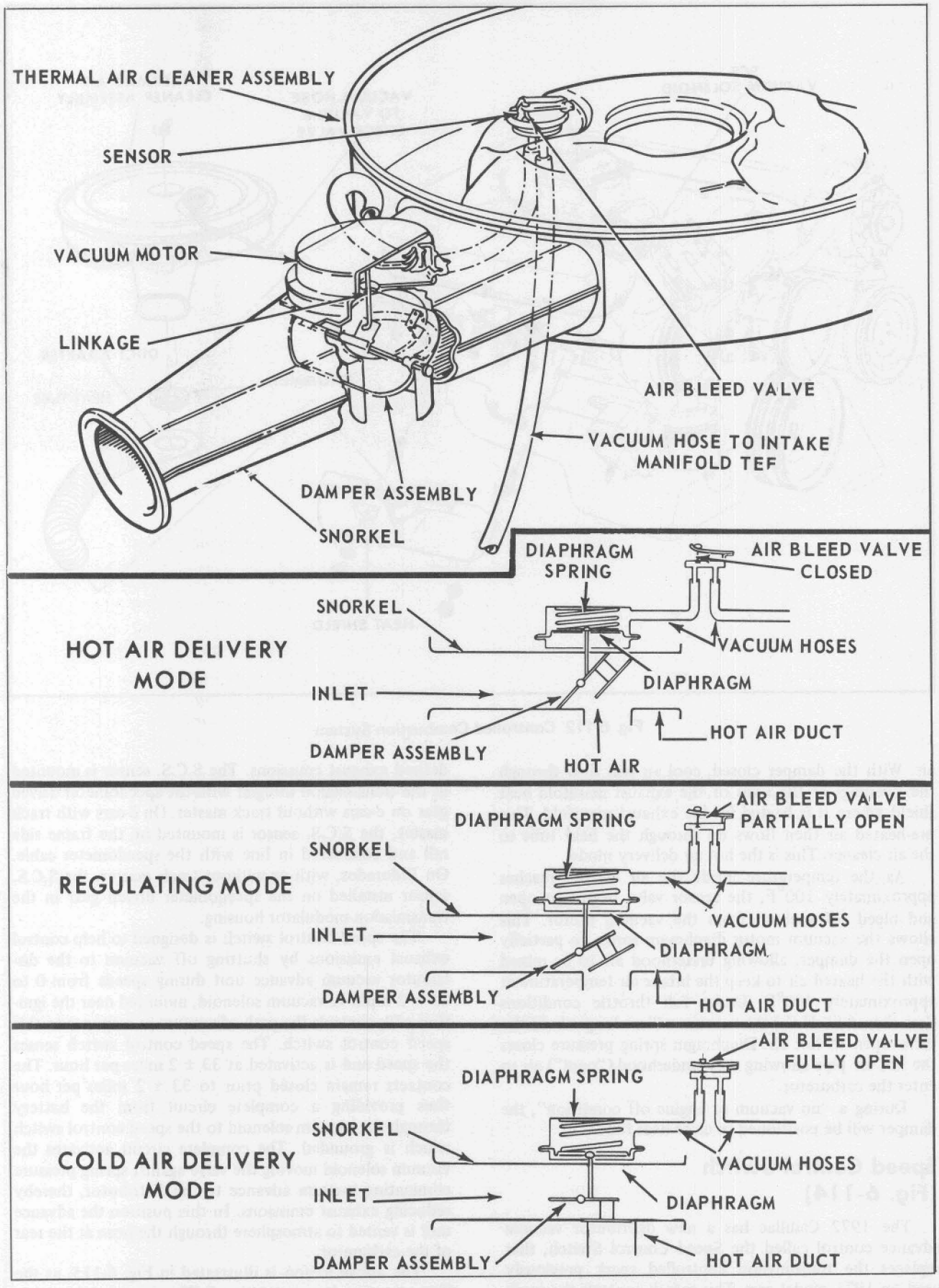


Fig. 6-113 Controlled Combustion System Operation

control switch separate, thus breaking the circuit and de-energizing the solenoid. With no current available at the solenoid, spring pressure forces the valve off of the vacuum port. The normal carburetor vacuum signal is now available allowing the distributor vacuum advance unit to operate normally for best fuel economy. This action is illustrated in Fig. 6-115 as the "normal vacuum advance position." When car speed is reduced for any reason below 25 mph, the contacts inside the speed control switch close and return the vacuum solenoid to the "no vacuum advance" position.

It should be noted that the speed control switch regulates only carburetor vacuum and does not affect operation of the thermal vacuum switch in its manifold supply position.

Evaporative Loss Control System (Fig. 6-116)

A fuel tank evaporation control system is used on all 1972 Cadillac cars to prevent emission of fuel vapors from the vehicle fuel system. This is accomplished by venting the fuel tank through a canister containing charcoal. When fuel evaporates or, in some cases, as liquid fuel is forced into the vents due to thermal expansion or maneuvering of the vehicle, the liquid and vapor are separated in the liquid-vapor separator shown just ahead of the fuel tank, Fig. 6-116.

The separator catches the liquid fuel and returns it to the tank but allows the vapor to pass through into a line connected to the canister mounted on the rear of the radiator cradle. The canister adsorbs fuel vapors into a bed of activated charcoal and retains them until the canister is purged or cleared by air drawn through the line to the engine air cleaner. The adsorbing occurs when the vehicle is parked and purging or cleaning the charcoal bed occurs when the engine is operated.

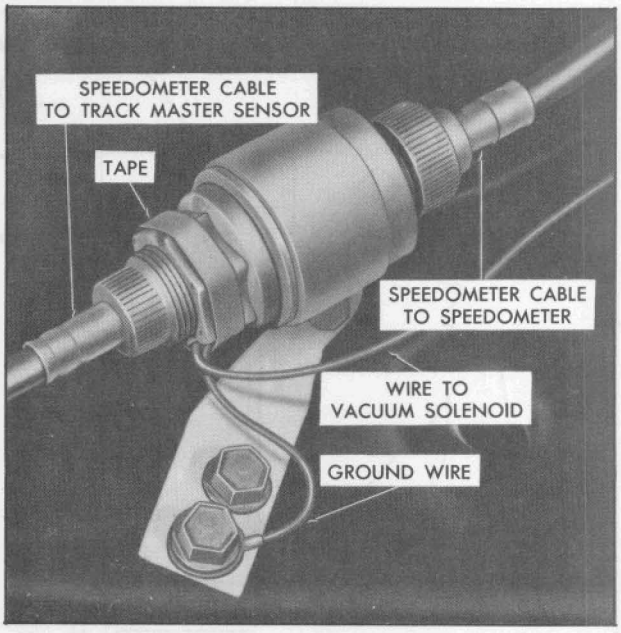


Fig. 6-114 Speed Control Switch W/TM, Exc. Eldorado

The only service normally required for the E.L.C. system is to replace the filter located in the bottom of the canister each 12 months or 12,000 miles. More frequent replacement of the element may be necessary if the vehicle is frequently driven in dusty areas.

CAUTION: The hoses used in this system are specially manufactured and if replacement becomes necessary it is important to use only hose marked "EVAP" on the hose.

DIAGNOSIS OF EMISSION CONTROL SYSTEMS

A.I.R. PUMP DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Excessive Belt Noise	Loose belt. Seized pump.	Tighten belt. Replace pump.
Excessive Pump Noise, Chirping, Rumbling or Knocking	Leak in hose. Loose hose. Hose touching other engine parts. Diverter valve failure. Check valve failure. Pump mounting fasteners loose. Centrifugal fan damaged. Pump failure.	Locate source of leak and correct. Reassemble and replace or tighten hose clamp. Adjust hose position. Replace valve. Replace valve. Retorque all mounting screws. Replace centrifugal fan. Replace pump.

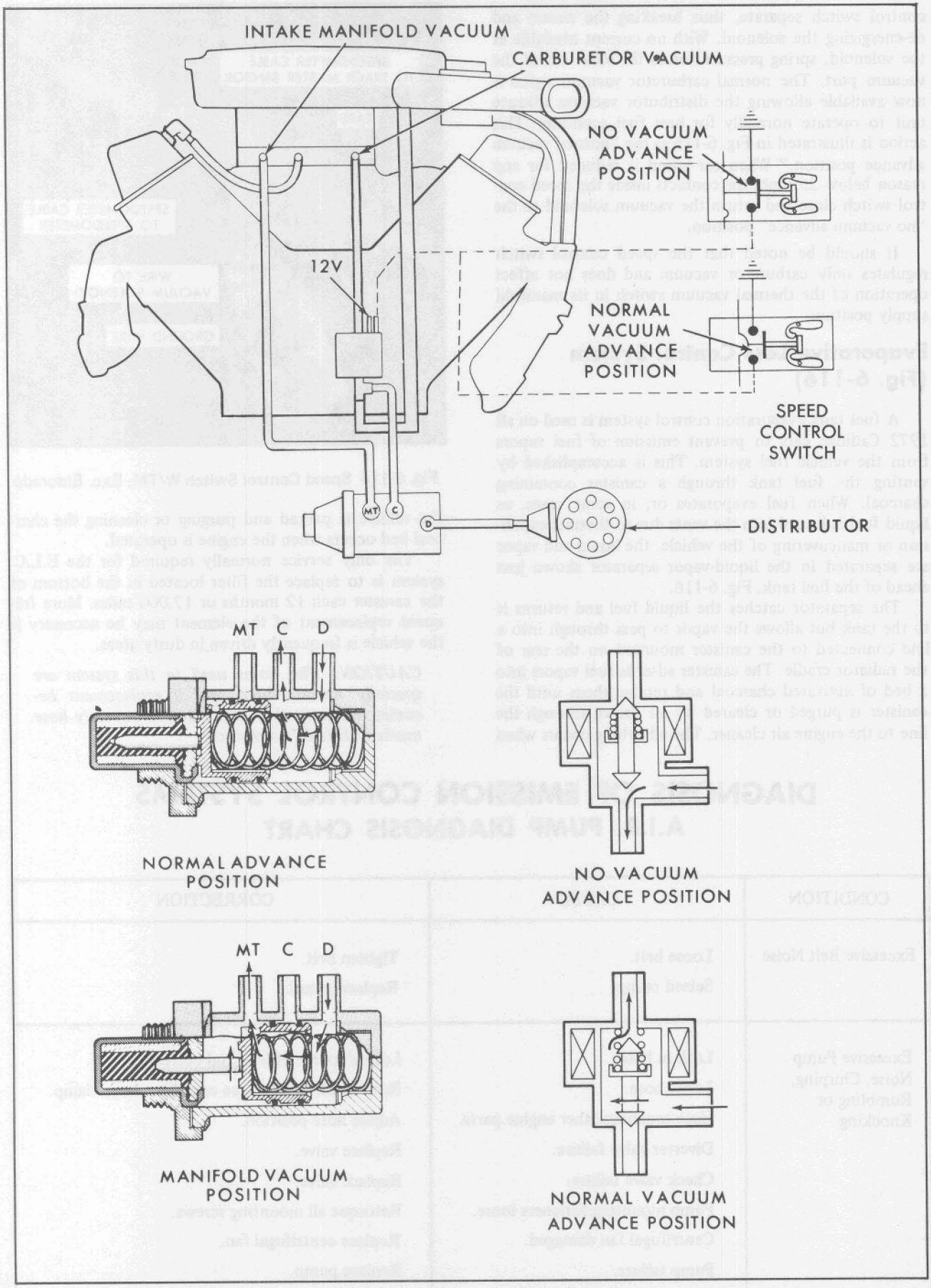


Fig. 6-115 Vacuum Advance Controls

DIAGNOSIS OF EMISSION CONTROL SYSTEMS
A.I.R. PUMP DIAGNOSIS CHART (Cont'd.)

CONDITION	CAUSE	CORRECTION
No air supply.	Loose belt.	Tighten belt.
	Leak in hose.	Locate source of leak and correct. Reassembly and replace or tighten hose clamps.
	Leak at hose fitting.	
	Diverter valve failure.	Replace valve.
	Check valve failure.	Replace valve.
	Pump failure.	Replace pump.

CRANKCASE VENTILATOR VALVE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE
Slow, unstable idle, rolling, frequent stalling, breather backflow.	Valve completely plugged, or stuck in backfire (engine off) position.
Engine operation OK, but breather backflow at heavy throttle.	Valve stuck in idle position.
Rough, fast idle. Engine stalls. No backflow.	Valve stuck in intermediate position.

(NOTE: If the valve is inoperative, it should be replaced.)

94. Testing Thermac Air Cleaner

1. Check heat tube and vacuum hoses for condition and secure connections. Repair or replace as required before further testing.

2. With engine off, remove air cleaner cover and tape Thermometer, J-5421, to air cleaner base next to sensor.

3. Allow a short time for thermometer reading to stabilize. Read thermometer and proceed on following basis: If temperature is below 80°F, continue with step 4. If temperature is above 80°F, remove air cleaner and allow it to cool to approximately 75°F.

4. Install a vacuum gage in the vacuum line between sensor and vacuum motor.

5. Check position of control damper by looking in end of snorkel. Damper should be open.

6. Install cover on air cleaner without wingnut and start engine.

7. If ambient temperature is above 85°F, proceed to step 10.

8. If ambient temperature is below 85°F, observe position of damper in snorkel. When damper begins to move toward the open (outside air) position, immediately remove air cleaner cover and record temperature and vacuum readings.

9. Replace air cleaner cover and continue watching damper.

10. If ambient temperature has risen above 85°F, it is only necessary to make sure damper is completely open by 105°F. When damper moves to full open position, again remove air cleaner cover and record temperature and vacuum readings.

11. Compare readings obtained in steps 8 and 10 with following chart:

Damper Position	Temperature Reading, °F	Vacuum Reading in Hg.
Starts to Open	85°	Full
Full Open	105°	5"-9"

12. Replacement of thermac air cleaner components should be based on following information.

a. If temperature is within specifications, thermac air cleaner is functioning properly.

b. If temperature is out of specification, but vacuum is correct, replace sensor as described in Note 103.

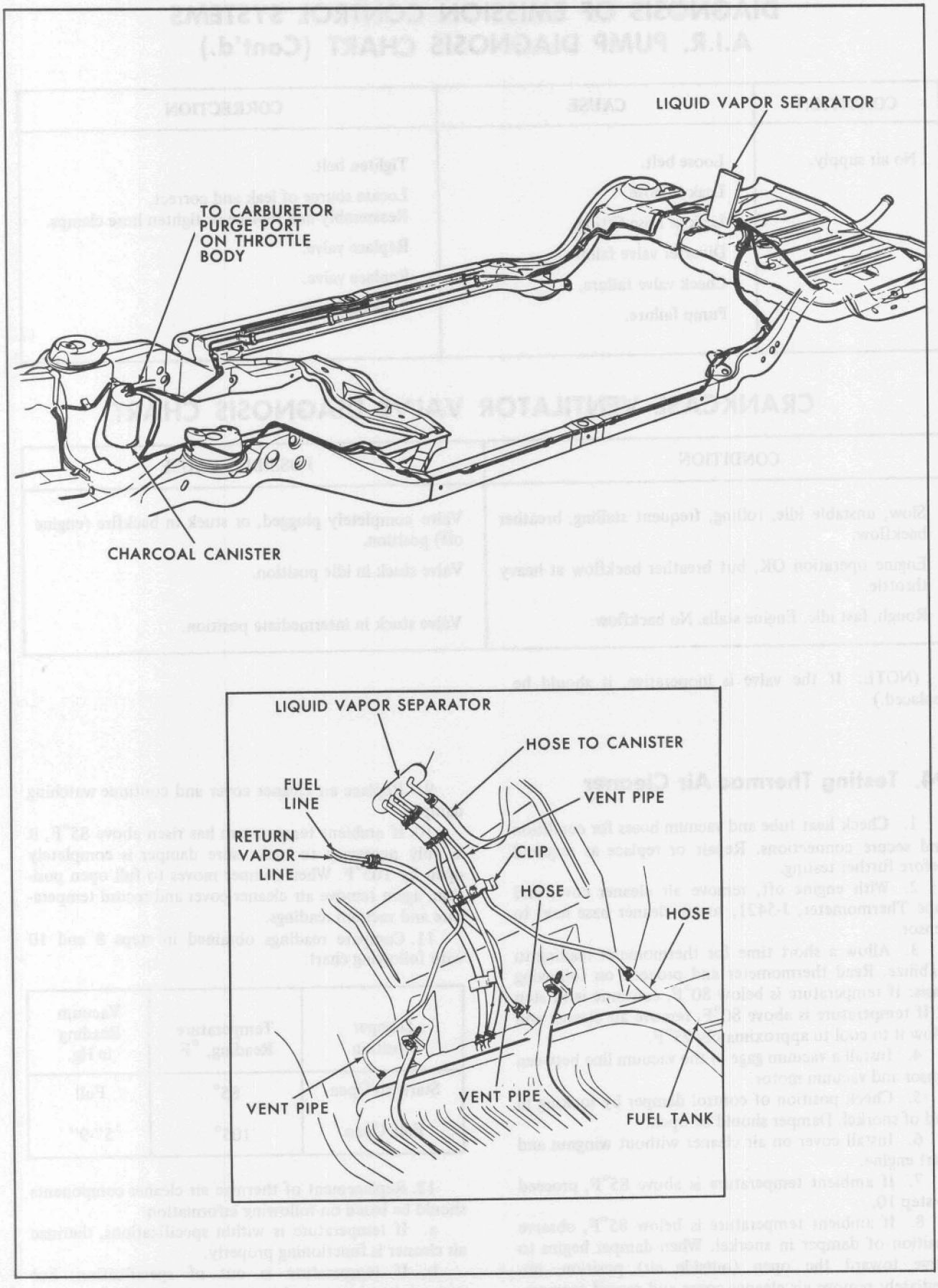


Fig. 6-116 Evaporative Loss Control System

c. If damper does not open at correct temperature, proceed to Step 13.

13. With engine at idle speed, disconnect damper assembly vacuum hose at sensor unit. Damper door should move to open (outside air) position. If damper does not open, check linkage for a binding condition.

14. Reconnect damper assembly vacuum hose with engine at idle speed. With vacuum gage reading of at least 9 in. Hg. (connect to manifold vacuum fitting if sensor is open) damper door should close snorkel passage (hot air position). If damper does not close, there is a vacuum leak in the vacuum motor diaphragm. Replace vacuum motor as described in Note 104.

95. Speed Controlled Switch System

Testing the speed controlled switch system should be accomplished under actual driving conditions as follows:

1. Disconnect the double connector at the vacuum solenoid and insert a test light between the connector leads. Test light leads must be long enough to allow the lamp to be located outside the engine compartment.

2. Tape the test lamp to the fender, cowl or some other visible area and close hood.

3. Drive the car and observe the test light for the following conditions:

a. Lamp should go out at 33 ± 2 miles per hour.

b. Lamp should come on again as vehicle speed descends below 25 miles per hour.

4. If test lamp does not operate as described in step 3, connect a jumper wire between the 18B wire and ground.

5. If light comes on, replace switch and repeat step 3. If the light does not come on, the circuit is open ahead of the solenoid.

6. To test operation of the vacuum solenoid, proceed as follows:

a. Connect a jumper wire between one of the solenoid terminals and ground.

b. Momentarily touch a jumper wire from the battery positive terminal to the other solenoid terminal.

c. A "click" should be heard or solenoid operation felt each time the jumper is connected.

7. If the solenoid fails to operate as described in step 6, replace solenoid.

(NOTE: The preceding evaluations may be done in the shop with a rear wheel drive model car on the hoist if proper safety precautions are taken.)

WARNING: ON-THE-HOIST EVALUATION SHOULD NEVER BE ATTEMPTED ON THE ELDORADO. WORKING NEAR ROTATING WHEELS COULD CAUSE INJURY OR VEHICLE DAMAGE.

SERVICE INFORMATION

96. Crankcase Ventilating Breather Assembly (Fig. 6-108)

a. Removal

1. Pull breather assembly from grommet on side of air cleaner.

2. Remove breather from grommet on left rocker arm cover.

b. Installation

1. Insert breather into grommet in left rocker arm cover.

2. Insert breather assembly into grommet in air cleaner.

97. Positive Crankcase Ventilator Valve Replacement (Fig. 6-109)

a. Removal

1. Disconnect valve from rubber elbow on right rocker arm cover.

2. Release hose clamp and hose from ventilator valve grommet.

b. Installation

1. Place a small amount of silicone on both ends of new ventilator valve.

2. Install new valve with smaller end into hose.

3. Secure hose to valve with clamp.

4. Install larger end of ventilator valve to right rocker arm cover grommet.

98. A.I.R. System Check Valve

a. Removal

1. Release clamp and disconnect air hose from check valve.

2. Unscrew check valve from manifold fitting.

b. Installation

1. Screw check valve onto manifold fitting.

2. Position air hose on check valve and secure with clamp.

99. A.I.R. System Silencer (Fig. 6-111)

The silencer is staked to the diverter valve and cannot be removed. If a damaged silencer is encountered, the diverter valve and silencer assembly must be replaced.

100. A.I.R. System Diverter Valve and Silencer Assembly (Fig. 6-111)

a. Removal

1. Disconnect vacuum hose from diverter valve.

2. Release clamp and remove air hose from fitting on diverter valve.

3. Remove two screws securing diverter valve and silencer assembly to pump and remove diverter valve assembly.

4. Remove gasket material from diverter valve and pump flanges.

b. Installation

1. Position new gasket on pump flange.

2. Position diverter valve on pump flange and secure with two screws.

3. Connect air hose to diverter valve fitting and secure with clamp.

4. Connect vacuum hose to fitting on diverter valve.

101. A.I.R. System Centrifugal Filter Fan (Fig. 6-111)

The centrifugal filter fan should not be cleaned, either with compressed air or solvents.

CAUTION: Centrifugal fan should not be removed from pump unless it is damaged, as removal procedures will destroy impeller.

a. Removal

1. Remove pump drive belt.

2. Remove three screws and remove pump pulley, Fig. 6-113.

3. Break remaining portion of centrifugal fan off pump hub, being careful that fragments do not enter air intake hole.

b. Installation

1. Position new centrifugal fan on pump hub.

2. Position pump pulley against centrifugal fan.

3. Install three pulley screws and tighten equally to 60 inch-pounds. This will press centrifugal fan onto pump hub. Do not drive centrifugal fan on with hammer.

(NOTE: The slight amount of interference with the housing bore is normal. After a new fan has been installed, it may squeal upon initial operation or until its O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.)

4. Install pump drive belt.

5. Adjust drive belt tension as described in Note 10d.

102. A.I.R. Pump

Servicing of this pump should be limited to replacement of the entire pump. Do not open pump for any reason. Do not clamp it in a vise or use a hammer or pry bar on the pump housing. If pry bar is used during belt tensioning, pry as close to rear of pump cover as possible.

a. Removal

1. Raise car and place on jack stands.

2. Remove air hose from diverter valve.

3. Disconnect vacuum line from fitting on diverter valve.

4. Remove three screws securing pulley to pump and remove pulley and belt.

5. Remove mounting bolt at top of air pump.

6. Remove adjusting bolt from bottom rear of pump and remove pump and diverter valve as an assembly.

b. Installation

1. Lift pump up through space between lower radiator hose and oil filter. Rotate pump so that diverter valve passes over oil filter.

2. Position pump against mounting bracket and loosely install upper screw.

3. Loosely install adjusting bolt at lower rear of pump.

4. Install pulley and drive belt. Adjust drive belt as described in Note 10d.

5. Tighten both mounting and adjusting screws to 25 foot-pounds.

6. Connect air hose to larger fitting of diverter valve and secure with clamp.

7. Install vacuum hose to small fitting on diverter valve.

103. Thermac Temperature Sensor

a. Removal

1. Detach hose between sensor and manifold fitting and remove air cleaner from engine.

2. Remove hose between sensor and vacuum motor, Fig. 6-117.

3. Pry retainer away from sensor vacuum fittings and remove retainer.

4. Note position of sensor and remove sensor with gasket from position in air cleaner.

b. Installation

1. Install gasket on sensor and install sensor to air cleaner in original position, Fig. 6-118.

2. Press retainer on vacuum connections.

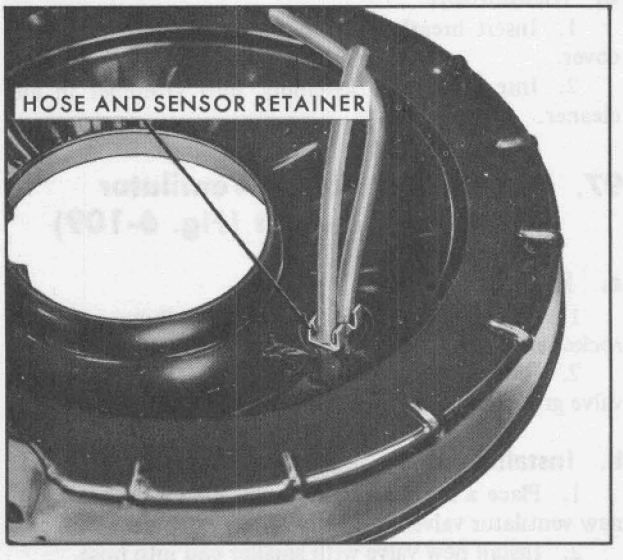


Fig. 6-117 Thermac Air Cleaner Sensor Hoses

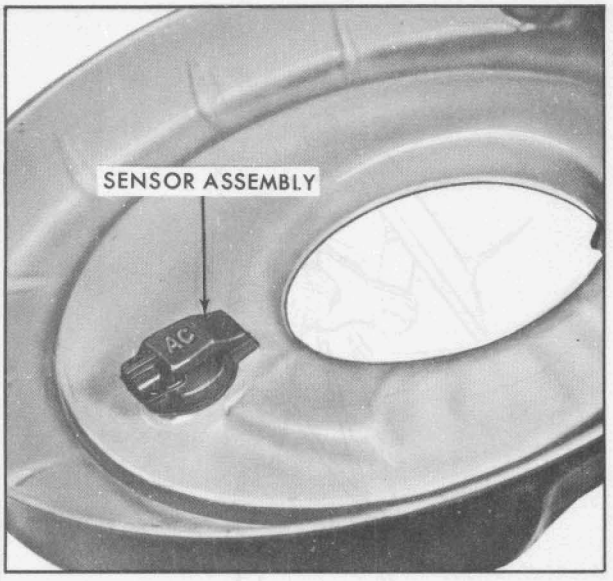


Fig. 6-118 Positioning Thermac Air Cleaner Sensor

3. Connect vacuum hose between sensor and vacuum motor. Install vacuum hose to remaining fitting.
4. Install air cleaner, making sure heat tube engages heat shroud on exhaust manifold.
5. Connect vacuum hose between sensor and manifold fitting.

104. Thermac Vacuum Motor

a. Removal

1. Disconnect hose between sensor and manifold fitting and remove air cleaner from engine.
2. Disconnect vacuum hose between motor and sensor.
3. Drill a 1/16" hole in the center of each spotweld holding vacuum motor to snorkel. Enlarge hole as necessary to remove retainer.
4. Remove retainer and lift motor slightly off air cleaner.
5. Twist motor to one side to disengage link from valve and remove motor.

b. Installation

1. Install link in valve and position motor on air cleaner snorkel.
2. Position retainer strap over motor and secure with two sheet metal screws.
3. Check operation of valve to see that screws do not interfere.
4. Connect vacuum hose between motor and sensor. Install vacuum hose on remaining fitting.
5. Install air cleaner, making sure heat tube engages heat shroud on exhaust manifold.
6. Connect vacuum hose between sensor and manifold fitting.

105. Exhaust Manifold Heat Shield

To replace the manifold heat shield, refer to Note 118.

106. Speed Control Switch Sensor (Except Track Master and 693) (Fig. 6-114)

a. Removal

1. Disconnect wire connector at switch.
2. Disconnect speedometer cable at switch.
3. Remove one bolt and retainer securing switch to transmission.
4. Remove switch by pulling out.
5. Remove speedometer drive gear from switch.

b. Installation

1. Install speedometer drive gear on switch.

(NOTE: See chart below for proper identification of speedometer gear.)

2. Install switch in transmission.
3. Install retainer and bolt securing switch to transmission.
4. Install speedometer cable to switch.
5. Install wire connector at switch.

Series	Speed Switch	Gear	
		Code	Teeth
681, 692, 693, 698	1600391	Blue	38
697	1600392	Black	40
681, 692, 683 with optional axle	1600392	Yellow	41

107. Speed Control Switch Sensor (With Track Master— Except 693) (Fig. 6-119)

a. Removal

1. Disconnect wire connector at switch.
2. Remove screw securing ground wire to frame.
3. Disconnect speedometer cable from both ends of switch.
4. Remove screw from bracket securing switch and remove switch.
5. Remove screw securing bracket to frame and remove bracket.

b. Installation

1. Install bracket to frame and secure with screws.
2. Install switch and secure to bracket with screw.
3. Connect speedometer cables to both ends.
4. Install ground wire and secure to frame with screw.
5. Connect wire connector at switch.

(NOTE: See chart above for proper identification of speedometer gear.)

108. Speed Control Switch Sensor (693 Only)

a. Removal

1. Disconnect wire connector at switch.

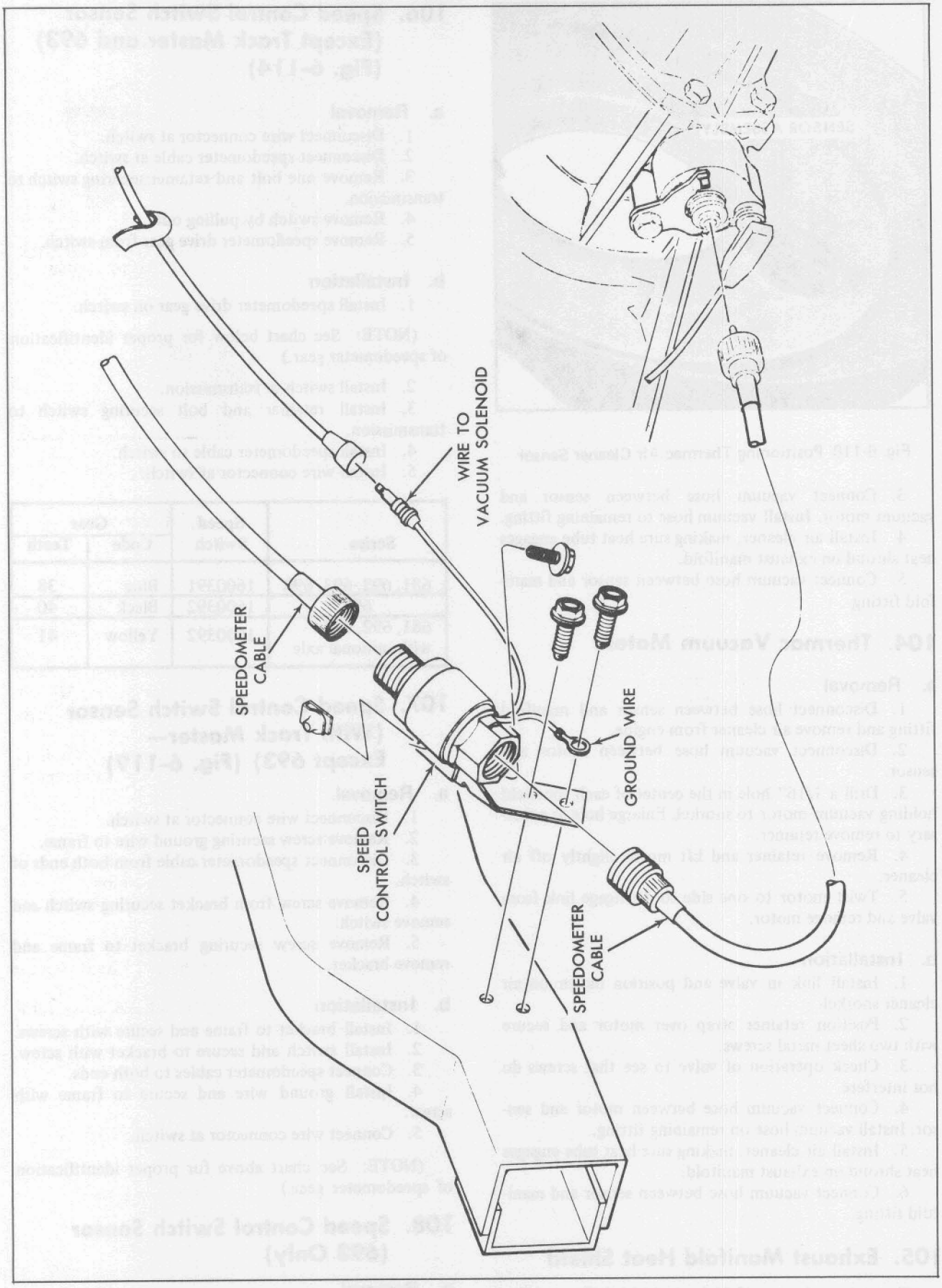


Fig. 6-119 Speed Control Switch W/TM Exc. Eldorado

2. Disconnect speedometer cable at switch.
3. Remove speed control switch.

b. Installation

1. Install speed control switch.
2. Connect speedometer cable to switch.
3. Connect wire connector at switch.

109. E.L.C. System Vapor Canister

a. Removal

1. Remove two hoses from top of canister. Canister is located on back of radiator cradle just to the left of the radiator.
2. Remove one screw holding canister strap type bracket to radiator cradle.
3. Remove strap and cannister from position on cradle.

b. Installation

1. Position canister on bracket behind radiator cradle with two fittings on top facing towards engine.
2. Secure strap around canister with one screw.
3. Connect two hoses to top of canister; large hose to air cleaner, small hose to tank.

110. E.L.C. System Vapor Canister Filter (Fig. 6-120)

a. Removal

1. Remove canister from position on radiator cradle as described in Note 109a.
2. Remove cover from bottom of canister by pulling to disengage clips.
3. Remove polyurethane element by squeezing out from under retainer bar, Fig. 6-120.

b. Installation

1. Squeeze element under retainer bar and position evenly around entire bottom of canister. Tuck edges under lip of canister.
2. Install bottom cover by snapping in place.
3. Install canister in position on radiator cradle as described in Note 109b.

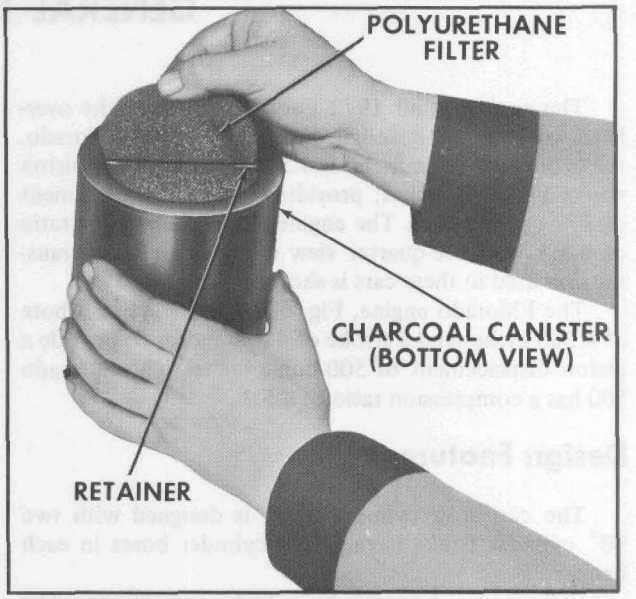


Fig. 6-120 Removing Canister Filter

111. E.L.C. System Liquid-Vapor Separator

a. Removal

1. Working under car, remove four hoses from nipples on separator, Fig. 6-116. Use a rag to catch spilled fuel.
2. Remove rear seat cushion and rear seat back. Refer to Section 15 of the 1972 Body Service Manual.
3. Remove cardboard panel separating passenger compartment from trunk compartment.
4. Remove four screws (two vertical; two horizontal) securing separator to body floor pan and remove liquid vapor separator.

b. Installation

1. Seal area of separator that passes through floor pan and position separator in installed position.
2. Secure separator to floor pan with four screws (two vertical; two horizontal).
3. Install cardboard panel, seat back and seat cushion. Refer to Section 15 of the 1972 Body Service Manual.
4. Working under car, install four hoses to separator as shown in Fig. 6-116 and secure with clamps. Fuel tank vent hoses are the three nipples grouped together while line to canister is single separate nipple.

GENERAL DESCRIPTION

The engine in all 1972 Cadillac cars is of the overhead valve 90°, V-8 design. On all cars except Eldorado, the cylinder bore diameter is 4.300 inches and the piston stroke is 4.060 inches, providing a piston displacement of 472 cubic inches. The engine has a compression ratio of 8.5:1. A three-quarter view of the engine and transmission used in these cars is shown in Fig. 6-121.

The Eldorado engine, Fig. 6-122 has a cylinder bore of 4.300 inches and a stroke of 4.304 inches to provide a piston displacement of 500 cubic inches. The Eldorado 500 has a compression ratio of 8.5:1.

Design Features

The cast iron cylinder block is designed with two 90° cylinder banks having four cylinder bores in each bank.

Cylinder numbering is by cylinder arrangement. The right front cylinder is number one, and the left front is number two. Cylinders on the right bank have odd numbers (1, 3, 5, and 7) and those on the left bank have even numbers (2, 4, 6, and 8).

The firing order is 1-5-6-3-4-2-7-8.

The crankshaft is designed to provide a 4.060 or 4.304 inch stroke. The cast nodular iron crankshaft has two and one-half inch diameter connecting rod journals and incorporates five three and one-quarter inch diameter main bearing journals with shell-type inserts of steel-backed aluminum and steel-backed babbitt construction. End thrust of the crankshaft is taken by the center main bearing. Six counterweights are integral with the crankshaft. A harmonic balancer is secured by four screws to a flanged hub pressed on the front end of the crankshaft.

Connecting rods for pistons of opposite cylinders are carried side by side on the same crankpin. Shell type connecting rod bearings are steel-backed aluminum.

The cast aluminum pistons use two compression rings and one oil ring. To provide a non-scuffing surface when the engine is new, the pistons are tin-plated. A trough on the top of each piston increases the turbulence of the fuel mixture in the combustion chamber for more complete burning.

Piston pins are press-fitted into the connecting rods. Broached grooves in each piston pin bore direct oil from the cylinder wall to the piston pin to provide adequate lubrication.

The camshaft is supported by five steel-backed babbitt bearings. It is driven by the crankshaft through a timing chain at the front of the engine. Both the crankshaft and camshaft sprockets have locating marks to provide correct valve timing when the timing chain is installed. Wide camshaft lobe design assures minimum lobe wear.

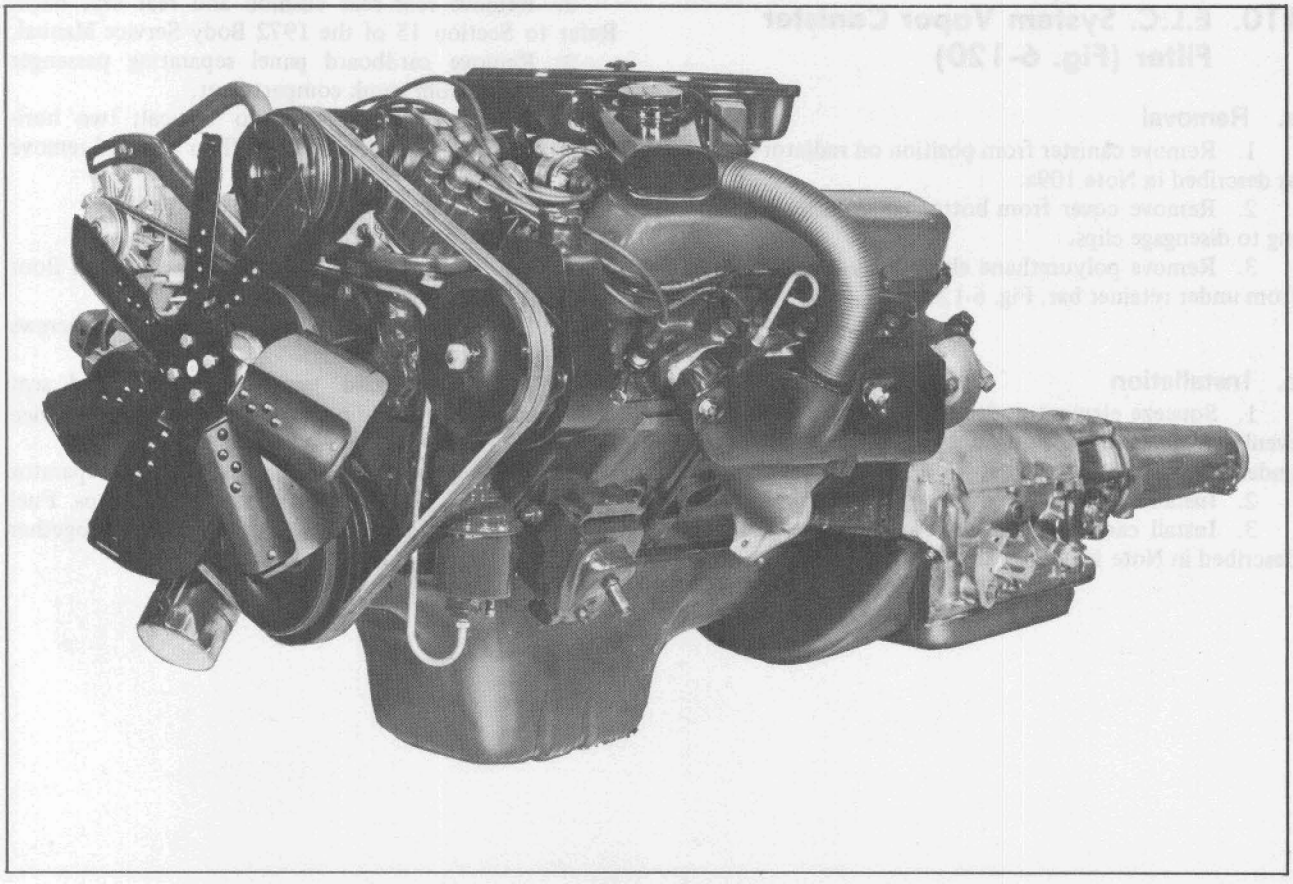


Fig. 6-121 472 Cubic Inch Cadillac Engine

A drive gear, cast as an integral part of the camshaft, meshes with the driven gear on the distributor drive shaft, Fig. 6-123. The distributor drive shaft rotates in a clockwise direction when viewed from above. This shaft also drives the oil pump.

Hydraulic valve lifters are used to maintain zero operating clearance throughout the valve train. This arrangement assures quiet operation and eliminates the need for valve tappet adjustments. The lifters operate in guide holes bored in the cylinder block. The valve lifter plunger and lifter body are selectively fitted in matched pairs. The push rods ride in cups in the lifters and extend up through openings in the cylinder heads to the rocker arms. The valve operating mechanism is illustrated in Figs. 6-124 and 6-128.

A full flow type oil filter is attached to the oil pump housing. The filter assembly incorporates a throw away type filter element and a spring loaded by-pass valve integral with the pump assembly, to assure that the engine oil supply is not interrupted if the element should become clogged.

Oil capacity of the engine crankcase on all series cars except the Eldorado is four quarts; five quarts should be added if the filter is changed.

Oil capacity of the Eldorado crankcase is five quarts; six quarts should be added if the filter is changed.

Engine Lubricating System

The oil pump is mounted on the right side near the front of the engine, Fig. 6-125. Oil enters the pump through a screened intake pick-up pipe, and is pumped through the oil filter, through an angular passage in the cylinder block into the right longitudinal header, Fig. 6-125, and crosses over to the left longitudinal header through intersecting vertical passages above the No. 2 camshaft bearing.

The oil continues up the left longitudinal header to the oil pressure signal switch.

Main bearings No. 2, 3, and 4 are lubricated by oil from the right longitudinal header through holes drilled in the block. Main bearings No. 1 and 5 are lubricated in the same manner by oil from the left longitudinal header. The camshaft bearings are lubricated by oil from the corresponding main bearings through holes drilled in the block. Oil from each main bearing also lubricates adjacent connecting rod bearings through holes drilled in the crankshaft. (See Fig. 6-125.)

The longitudinal headers feed the hydraulic valve lifters through drilled passages, (Fig. No. 6-127). The oil then flows, under pressure, into the lifters and up through the hollow push rods to the rocker arms. The amount of oil is controlled by a small metering disk in

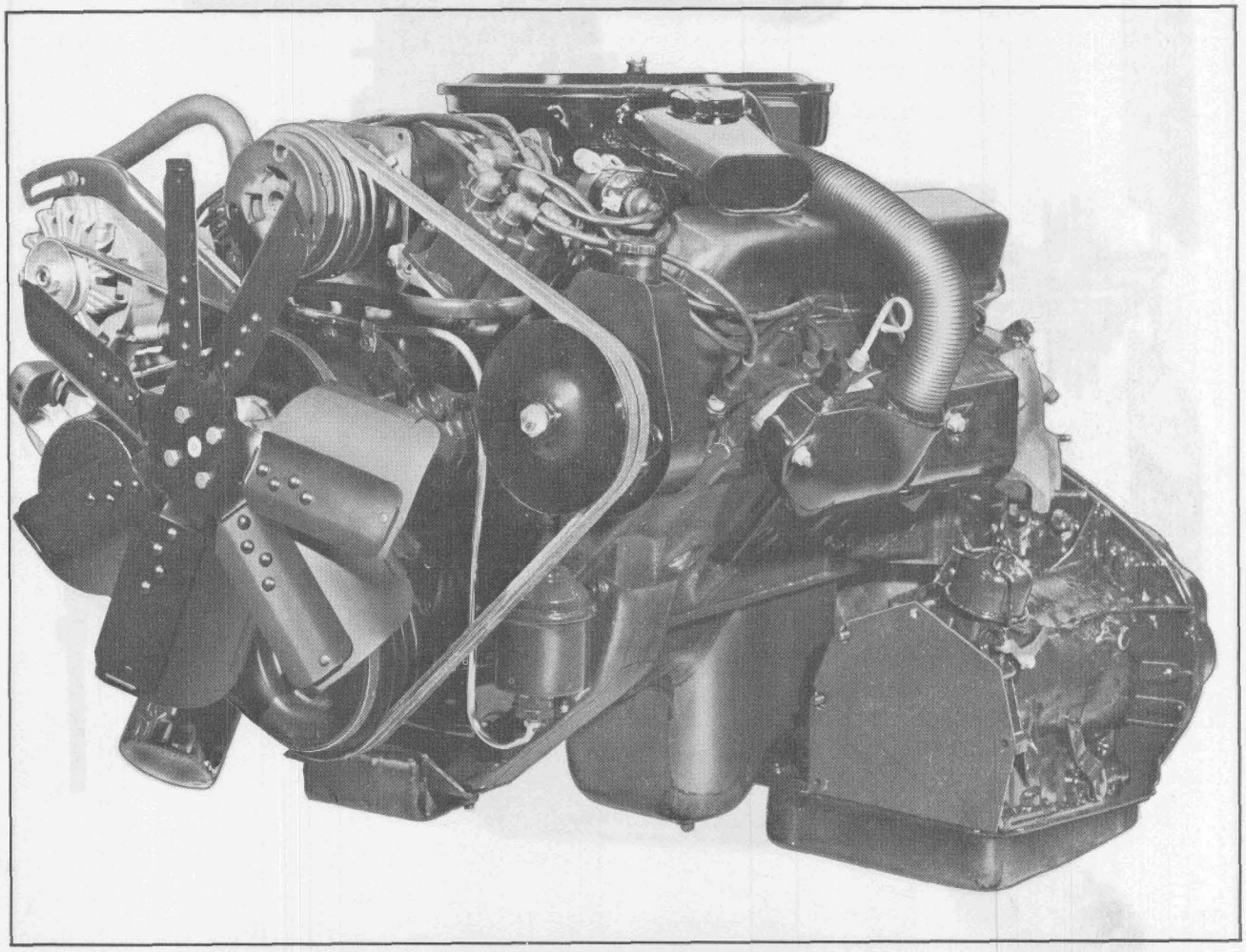


Fig. 6-122 500 Cubic Inch Eldorado Engine

the valve lifter.

The oil comes through a small feed hole in the rocker arm and flows onto the arm, lubricating the rocker arm pivot points as well as the push rod tip and the valve tip.

Oil drains from the cylinder heads into the valve lifter compartment and returns to the crankcase through a hole on the bottom of the compartment.

Information pertaining to the Crankcase Ventilation System is given in the Emission Control Section.

112. Engine Removal and Installation—Except Eldorado

a. Removal

1. Disconnect negative battery cable.
2. Remove hood as described in Section 11, Note 2.
3. Remove carburetor air cleaner and heat shroud.
4. Drain radiator.
5. Remove upper radiator hose bracket at cradle.
6. Remove six screws securing radiator cover if so equipped.
7. Remove radiator cover.
8. Remove fan as described in Note 8a.

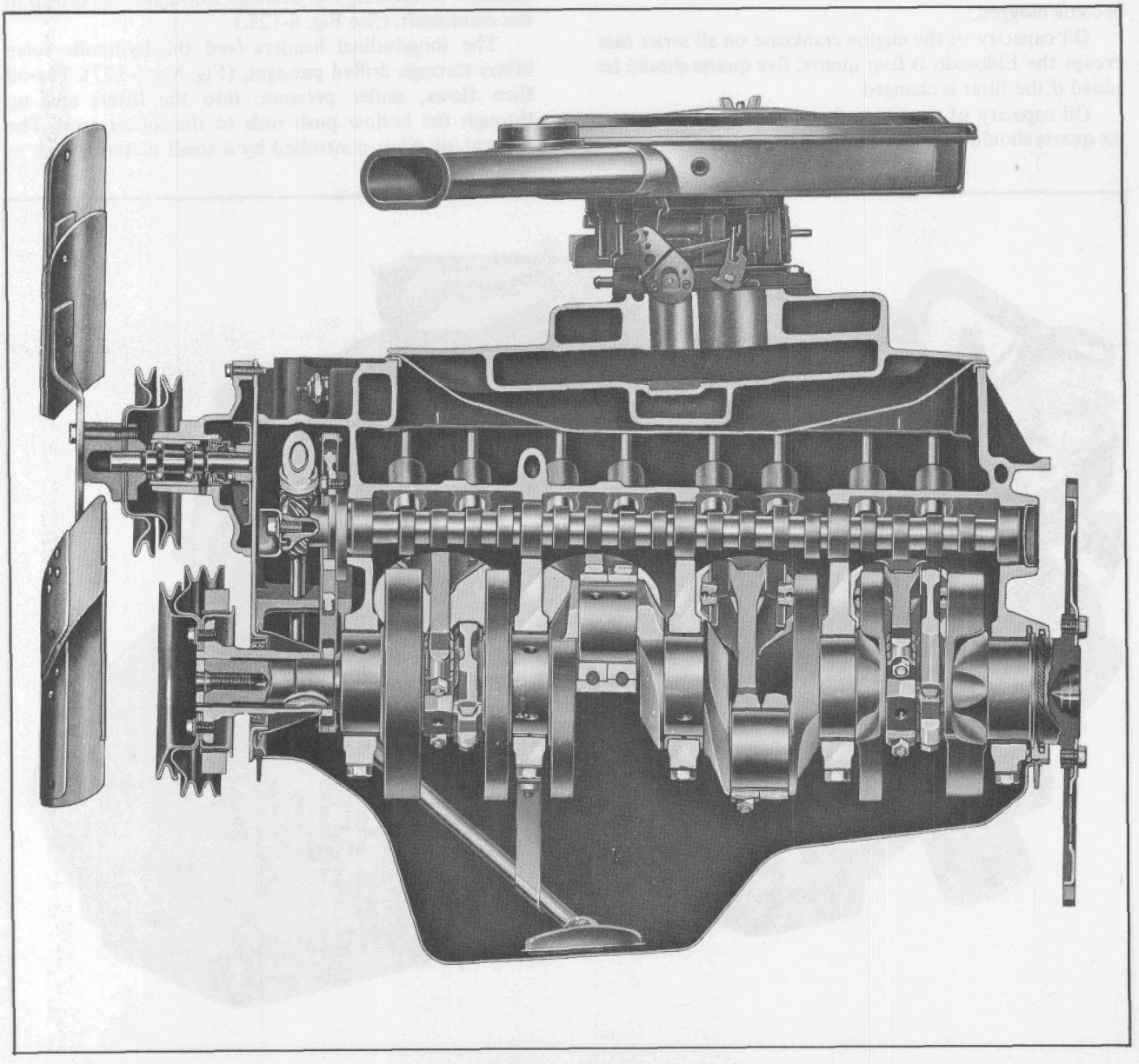


Fig. 6-123 Engine Longitudinal Section

9. Remove upper radiator hose from thermostat housing.

10. Disconnect throttle and Cruise Control linkage at carburetor and position out of way.

11. Partially remove power steering pump by performing steps 2 through 6 of Note 7a in Section 9.

12. Partially remove air conditioning compressor as described in Section 1, Note 9a.

13. Disconnect wires at following locations: coolant temperature sender connector (green wire near coil); ignition coil (+ terminal); downshift switch; S.C.S. solenoid; anti-dieseling solenoid; engine temperature switch.

14. Bend back clips on left rocker arm cover and position wiring harness out of way.

15. Remove vacuum hoses from rear of carburetor and hose from tee at rear of intake manifold. Remove purge hose at canister.

16. Disconnect wires at the following locations: generator; heater turn-on switch; oil pressure switch.

17. Repeat Step 14 for right.

18. Remove hot water valve hose from fitting in rear of right hand cylinder head.

19. Loosen generator and remove belt.

20. Loosen A.I.R. pump and remove belt.

21. Remove two nuts securing tie strut to wheel house and loosen one nut securing tie to cowl. Position tie strut out of way.

22. Repeat step 21 for opposite side.

23. Remove two upper transmission to engine screws. Right hand screw secures transmission dipstick tube and modulator line to engine.

24. Raise car on hoist.

25. Remove starter motor as described in Note 28a.

26. Remove two nuts at each exhaust manifold and remove exhaust pipe from manifold. Brace exhaust system so that it is not supported by the hangers.

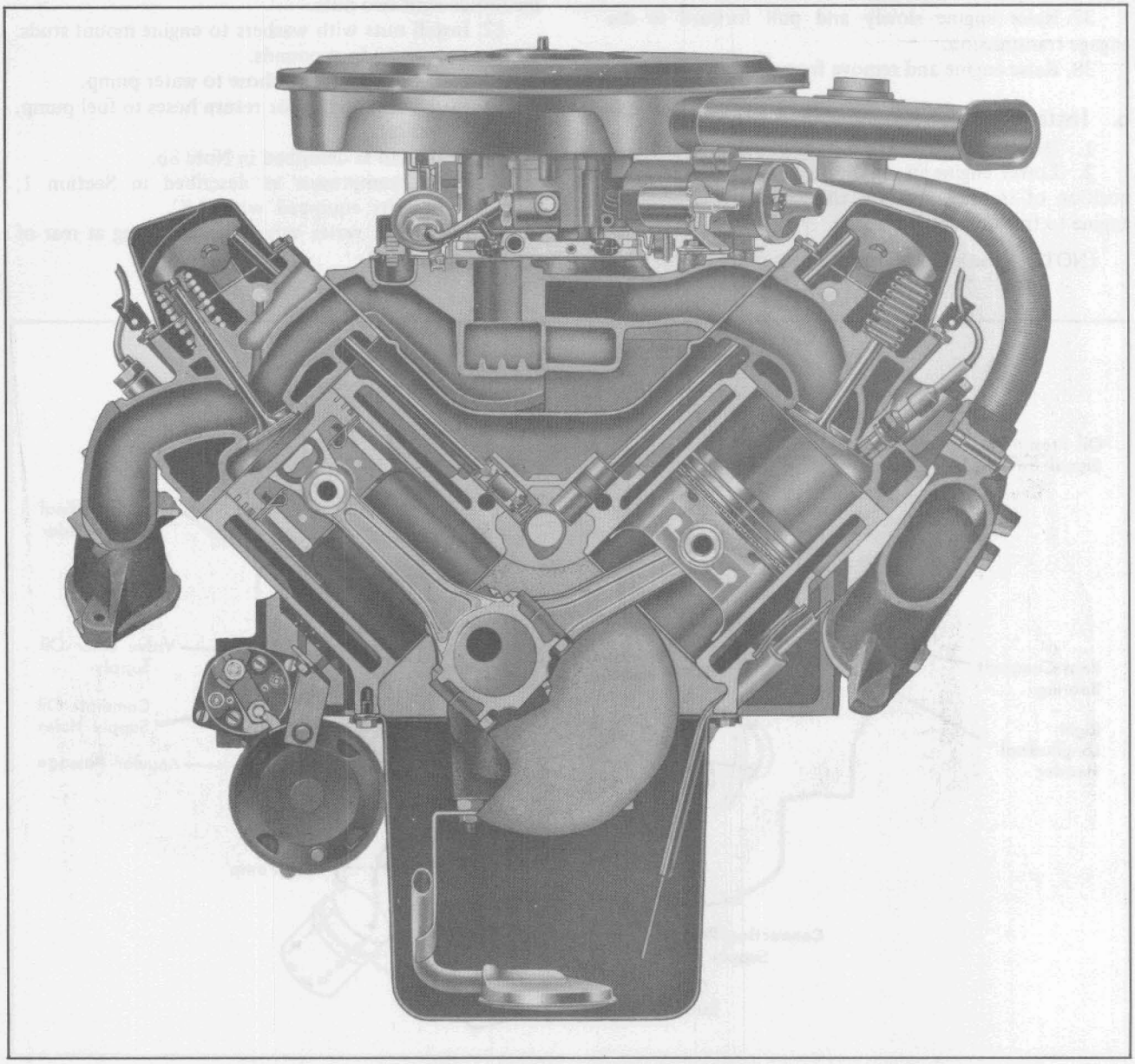


Fig. 6-124 Engine Transverse Section

27. Remove two nuts and washers securing front engine mounts to frame crossmember.

28. Disconnect and plug fuel line and vapor return line (A/C cars only) at fuel pump.

29. Remove lower radiator hose at water pump.

30. Remove four screws securing flywheel inspection cover to transmission and remove inspection cover.

31. Remove three screws securing flywheel to converter. Install a 1962 crankshaft balancer bolt and washer in end of crankshaft and rotate engine with breaker bar and socket for access to screws.

32. Remove four screws securing transmission to engine.

33. Lower car.

34. Move right hand lifting bracket to a position where it straddles the intake passage for #1 cylinder.

35. Place a lifting chain in lifting brackets and connect chainfall to lifting chain.

36. Support transmission with floor jack.

37. Raise engine slowly and pull forward to disengage transmission.

38. Raise engine and remove from car.

b. Installation

1. Raise transmission as high as possible.

2. Lower engine in chassis on an angle that matches position of transmission. Install two top bolts securing engine to transmission.

(NOTE: During this operation use care not to damage any items in the engine compartment (e.g. transmission dipstick tube, throttle linkage, etc.) Some twisting and maneuvering of the engine is sometimes required.)

3. Release the floor jack's support of the transmission.

4. Lower the engine completely, seating the left hand mount first and then the right.

5. Remove lifting equipment.

6. Raise car on hoist.

7. Install four remaining screws securing engine to transmission. Torque screws to 35 foot-pounds.

8. Install three screws securing flywheel to converter. Torque screws to 30 foot-pounds.

9. Position flywheel inspection cover to transmission and secure with four screws.

10. Install starter motor as described in Note 28b.

11. Raise exhaust pipes into position and secure to manifolds with two nuts.

12. Install nuts with washers to engine mount studs. Torque nuts to 52 foot-pounds.

13. Install lower radiator hose to water pump.

14. Install fuel and vapor return hoses to fuel pump.

15. Lower car.

16. Install fan as described in Note 8b.

17. Install compressor as described in Section 1, Note 9b, on cars equipped with A/C.

18. Install hot water valve hose to fitting at rear of right cylinder head.

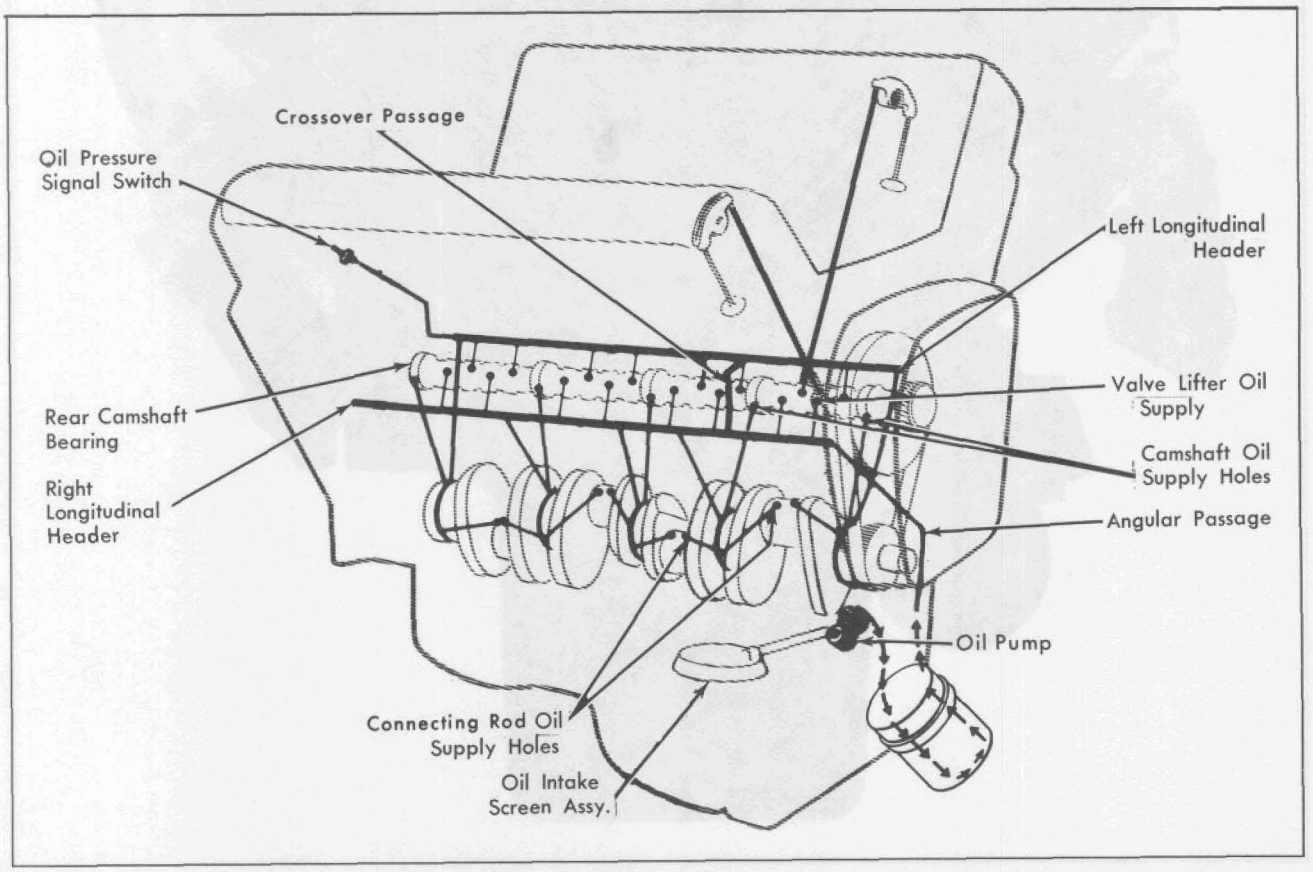


Fig. 6-125 Engine Lubricating System

19. Position tie struts to wheelhouse and secure with two nuts at each side. Retighten bolts at cowl.

20. Install power steering pump as described in steps 1 through 5 of Note 7a, Section 9.

21. Remove upper right transmission to engine screw and fasten transmission dipstick tube and vacuum modulator lines with this screw.

22. Make electrical connections at the following locations: engine temperature switch; anti-dieseling solenoid; S.C.S. solenoid; downshift switch; ignition coil (+ terminal); coolant temperature sender connector (green wire near coil); generator; heater turn-on switch; oil pressure switch.

23. Route wiring harness along both rocker arm covers and bend tabs closed to hold against cover.

24. Install power brake vacuum hose, S.C.S. vacuum hose and transmission vacuum modulator hose to rear of carburetor.

25. Install any drive belts that were removed.

26. Tension all belts as described in Note 10.

27. Connect throttle linkage at carburetor.

28. Check throttle linkage for proper operation.

29. Connect upper radiator hose to thermostat housing.

30. Position radiator cover and secure with six screws.

31. Install upper radiator hose bracket to cradle and secure with one screw.

32. Close drain cock and refill cooling system.

33. Install hose from carburetor purge port to vapor canister.

34. Check engine oil and adjust to proper level.

35. Visually inspect engine compartment and connect any items missed.

36. Connect battery cable.

37. Install air cleaner and hoses.

38. Start engine and check for leaks.

39. Shut off engine and install hood as described in Section 11, Note 2.

113. Engine Removal and Installation—Eldorado Only

a. Removal

1. Remove hood.

(NOTE: This operation may be performed by either one or two men. The operation is simplified by constructing four hood hinge to retainer bolts with the heads cut off. Use two at each side and install them in the hood hinge bolt holes as the regular bolts are removed. This will serve to locate the hood during

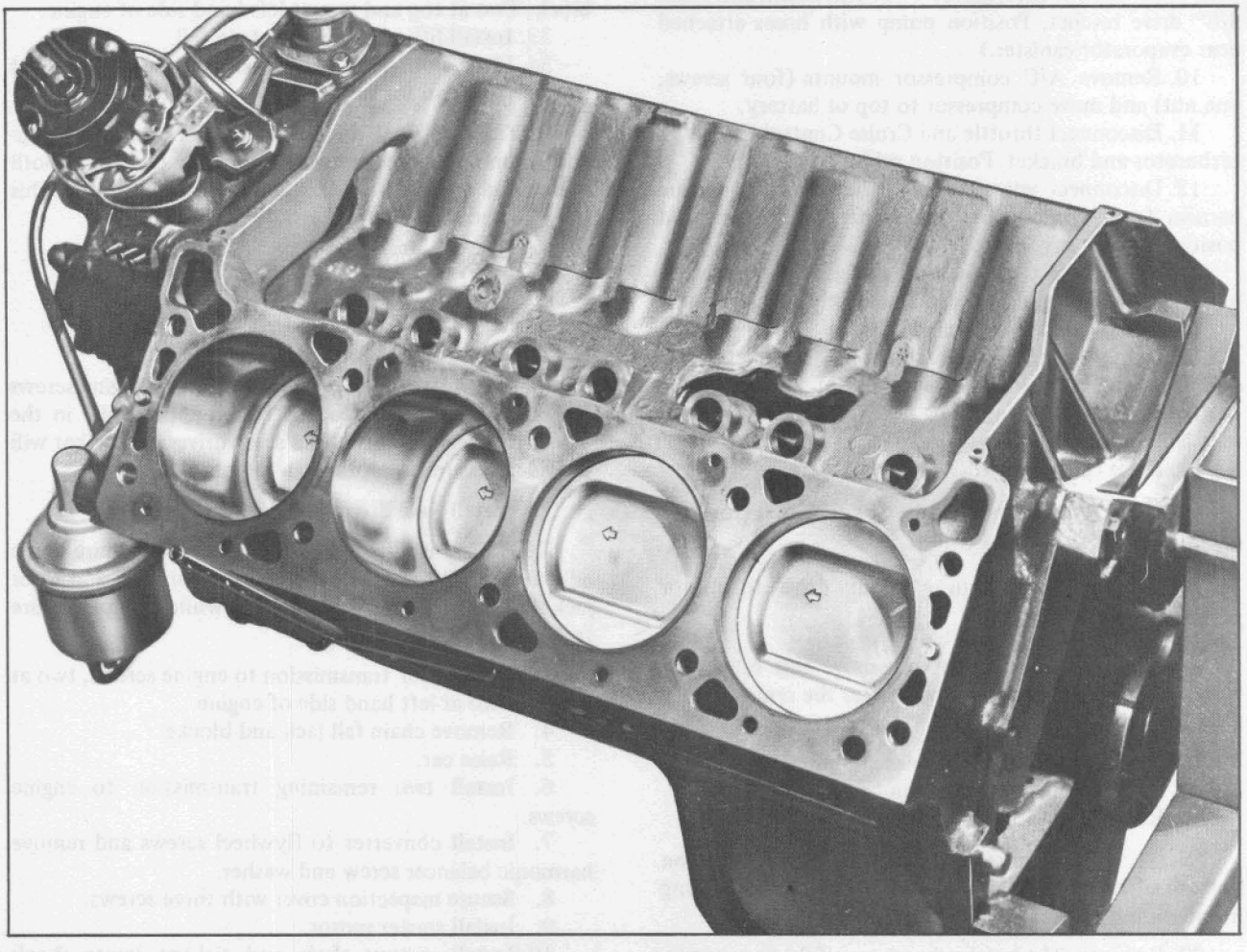


Fig. 6-126 Engine Partially disassembled

removal and installation.)

The one-man operation involves supporting the front of the hood with a fan belt wrapped through the hood bracing and hooked to a chainfall.

2. Open radiator petcock and raise rear of car to facilitate draining.
3. Remove carburetor air cleaner, vacuum hoses and hot air duct.
4. Remove upper radiator hose at thermostat housing and remove bracket at cradle.
5. Remove radiator cover - six screws.
6. Remove fan blade assembly.

(NOTE: This operation may be simplified by loosening the generator and rotating the fan to put each screw at the top in turn. Refer to Note 8.)

7. Disconnect battery negative cable, generator wires, right hand spark plug wires, heater turn-on switch and position harness out of way. Route spark plug wires away from top of compressor.
8. Disconnect water control valve hose at rear of block. Disconnect starter motor wiring harness at multiple connector.
9. Remove power steering pump (do not disconnect hoses) and position out of way. Remove all drive belts. (Lower power steering pump bolt is most easily removed with 9/16" flex socket, about 9" of extension, and small 3/8" drive ratchet. Position pump with hoses attached near evaporator canister.)
10. Remove A/C compressor mounts (four screws, one nut) and move compressor to top of battery.
11. Disconnect throttle and Cruise Control linkage at carburetor and bracket. Position cables out of way.
12. Disconnect wires on left hand branch of engine harness (coil, compressor, downshift switch, etc.) and position out of way.
13. Disconnect vacuum lines at S.C.S. solenoid and rear of carburetor and position out of way.
14. Remove left hand exhaust manifold flange nuts.
15. Remove transmission cooler line bracket screw and filler pipe nut from exhaust manifold.
16. Change right hand engine lift hook to position over No. 1 intake port.
17. Raise car on hoist.

(NOTE: A twin post hoist is preferred for this operation.)

18. Remove bolt securing final drive to motor mount.

(NOTE: It is preferable to remove this bolt now. However, if it will not come out, defer the removal until step 34.)

19. Disconnect fuel pump lines and plug.
20. Remove front engine mount nuts.
21. Remove lower radiator hose.

(NOTE: Drain hose and position out of way on bottom of car. Hose clamp is likely to be crushed during installation if not repositioned.)

22. Remove right hand exhaust manifold flange nuts.
23. Remove starter motor. Do not disconnect wiring from terminals.
24. Remove flywheel inspection cover.

(NOTE: It is possible to perform step 25 without removing this cover, however, removal of the three accessible bolts is necessary so the cover may be moved to reach converter screws. One cover screw is very difficult to reach.)

25. Remove flywheel-to-converter screws.

(NOTE: Use a 1962 Harmonic Balancer screw - #147 0868 and washer - #147 0867 to turn crankshaft.)

26. Remove two lower transmission-to-block screws.
27. Remove right hand output shaft screws.

(NOTE: This is easily done by one man if a long breaker bar is used. Hold tire with one hand and loosen screw with bar. When all screws are loose, use a small 3/8" drive ratchet with about 18" of extension.)

28. Remove two output shaft bracket to block screws and one screw securing bracket to final drive.
29. Loosen right hand shock absorber lower mounting nut and move shock outward on stud.
30. Move drive axle as far back as possible and remove output shaft.
31. Lower car.
32. Remove four screws securing transmission to block. Two at top and two at left hand side of engine.
33. Install lifting chain and chain fall.
34. Place floor jack with a soft (wood) face under transmission pan for support.

(NOTE: If final drive through bolt was not previously removed, remove now by applying tension to both engine and transmission in the correct proportions. This is a trial and error method.)

35. Remove engine.

b. Installation

1. Install engine.

(NOTE: Use of longer transmission to engine screws will simplify engine locating. Install these bolts in the top two holes. Use of a long screwdriver or pry bar will provide pressure at appropriate points.)

2. Install final drive through bolt.

(NOTE: Installation of the bolt will require some adjustment of the tension on both chain fall and floor jack but must be performed now while the pieces are free to move.)

3. Install four transmission to engine screws, two at top and two at left hand side of engine.
4. Remove chain fall jack and blocks.
5. Raise car.
6. Install two remaining transmission to engine screws.
7. Install converter to flywheel screws and remove harmonic balancer screw and washer.
8. Secure inspection cover with three screws.
9. Install starter motor.
10. Install output shaft and tighten lower shock mount nut.

11. Install right hand exhaust pipe flange nuts.
12. Install front engine mount nuts.
13. Connect fuel lines.
14. Install lower radiator hose.
15. Lower car.
16. Install fan blade assembly and belts as described in Note 8.
17. Install transmission cooler line bracket and dipstick tube bracket.
18. Install throttle and Cruise Control linkage.
19. Install left hand exhaust pipe flange nuts.
20. Install power steering pump.

(NOTE: Lower power steering pump bolt is most easily installed with a 9/16" flexible socket, about 9" of extension, and small 3/8" drive ratchet.)

21. Install A/C compressor.
22. Connect heater hose to cylinder head.
23. Connect remaining wires and vacuum hoses.
24. Install upper radiator hose.
25. Install radiator cover.

(NOTE: Weld nuts are used on these screws and are very fragile. Be sure screws are correctly started before tightening to avoid damaging weld nuts.)

26. Refill coolant.
27. Tension generator and power steering belts.
28. Install battery cable and air cleaner.
29. Install hood and align.
30. Start engine and check for leaks.

114. Engine and Transmission Support Mount (Except 693)

Three engine supports are used. The front support mountings are located on each side of the cylinder block and the rear support mounting is beneath the transmission extension housing.

The front support mountings are seated at an angle directly on the main front cross member of the frame and secured by studs. The rear support mounting at the transmission extension housing rests on a supporting cross member which is secured to the frame. All engines support mountings have rubber cushions to absorb vibrations and road shock.

It is important, when attaching the engine mountings to engine, transmission and frame, that the nuts and screws be tightened to the proper torque as follows:

Nut – Front Support Mount to Cylinder Block - 21 Foot-Pounds
Nut – Rear Engine Support Cross Member to Frame - 20 Foot-Pounds
Screw – Rear Support Mount to Rear Support Cross Member - 45 Foot-Pounds
Screw – Rear Support Mount to Transmission - 50 Foot-Pounds
Stud – Front Support Mount to Frame - 52 Foot-Pounds

Check at all three engine support mounting locations to be sure that no metal-to-metal contact can occur.

a. Front Engine Mount Removal

1. Raise car on hoist.
2. Remove two through bolts from mount to be replaced (left or right).
3. If left hand (driver's side) mount is being replaced, remove nut and washer from both mounts.
4. If right hand (passenger side– mount is being replaced, remove nut and washer from left hand mount and loosen right hand nut until no threads are visible on stud.
5. Support car with stands at each front frame horn.
6. Apply pressure (hoist, jack, etc.) to oil pan. Apply pressure over entire bottom of sump with no concentration of pressure due to bumps or knobs on lift.
7. Raise engine until mount may be removed.

CAUTION: Amount engine may be raised is limited due to clearance between fan and shroud. Use caution when raising engine to avoid damage to these components.

b. Front Engine Mount Installation

1. Position mount in place between cylinder block and frame.
2. Lower engine until through bolts may be installed through mount.
3. Continue lowering engine until it is in driving position.
4. Torque through bolt nuts to 21 ft. lbs.
5. Install nut and washer on mount stud and torque nut(s) to 52 ft. lbs.
6. Remove stands and lower car from hoist.

c. Transmission Mount Removal

1. Raise car on hoist.
2. Remove two mount to transmission extension housing bolts.
3. Remove two nuts, washers and bolts securing crossmember to frame on each side.

(NOTE: It may be necessary to pry floor pan up for clearance to remove bolts.)

4. Remove parking brake cable from bracket on cross member.
5. Position transmission support under extension housing or oil pan.
6. Remove cross member by raising transmission or lowering vehicle.
7. Remove two nuts and bolts and remove rear mount from position in cross member.

d. Transmission Mount Installation

1. Install rear mount to cross member with weld nuts up and secure with two nuts and bolts.
2. Install cross member and secure with two nuts, washers and bolts at each side.

(NOTE: Bolts should face down with nuts on bottom.)

3. Install two bolts securing mount to transmission extension housing.
4. Install brake cable in bracket at cross member.
5. Remove transmission support.
6. Lower car.

115. Engine and Transmission Mounts (693 Only)

Three engine supports are used to mount the engine on Eldorado models. The front support mounting is located behind and below the engine front cover assembly, and the two rear mountings are on the right and left of the transmission.

The front mount is seated on the main front cross bar (Fig. 2-4) of the frame and is secured by studs. The rear support mountings are actually transmission support mountings. The engine is bolted with six bolts to the transmission.

These engine and transmission support mountings have rubber cushions to absorb vibration and road shock.

It is important, when attaching the engine mountings to engine, transmission and frame that the proper torques be used.

Nut – Front mounting support bracket to crankcase bolt - 21 foot-pounds
Nut – Engine Front support cushion to frame stud - 35 foot-pounds
Nut – Engine front support cushion to engine mounting bracket bolt - 57 foor-pounds
Bolt – Engine rear support assembly to bracket - 50 foot-pounds
Bolt – Engine rear support cushion to bracket - 46 foot-pounds
Bolt – Engine rear support cushion to frame - R.H. side - 52 foot-pounds
Nut – Engine rear support cushion to frame - L.H. side - 52 foot-pounds

Check at all three engine support mounting locations to be sure that no metal-to-metal contact can occur.

(NOTE: Inter-lock must face forward on both engine rear support cushions.)

a. Front Engine Mount Removal

1. Remove fan as described in Note 8a.
2. Raise car.
3. Remove two nuts securing engine mount to frame cross member.
4. Position a stand under the crankshaft pulley and lower car until mount studs are disengaged from frame.

CAUTION: Transmission cooler lines and fuel lines must receive special handling to avoid damage.

5. Remove two bolts securing mount to mount adapter and remove engine mount.

b. Front Engine Mount Installation

1. Position mount in location on frame cross member.
2. Install two bolts securing engine mount to mount adapters. Torque bolts to 57 foot-pounds.
3. Position mount to frame by raising car.

CAUTION: Transmission cooler lines and fuel lines must receive special handling to avoid damage.

4. Install two nuts securing engine mount to frame cross member. Torque nuts to 35 foot-pounds.
5. Lower car.
6. Install fan as described in Note 8b.

c. Rear Engine Mount Removal

1. Raise car.
2. If left hand mount is to be removed, proceed with step 3; if right hand mount is to be removed, proceed to step 7. When replacing both mounts, remove and install one mount before removing other mount. Both mounts should not be removed at once.
3. Remove two screws with lock washers securing left hand mount to support plate.
4. Remove one nut securing left hand mount to cross member.
5. Support transmission oil pan near center of pan and lower car slightly; enough to remove mount.
6. Install left hand mount as described in part d.
7. Remove two screws with lock washers securing right hand mount to support plate.
8. Remove one screw with lock and flat washers securing right hand mount to cross member.
9. Support transmission oil pan near right hand edge of pan and lower car slightly; enough to remove mount.

d. Rear Engine Mount Installation

1. Position rear engine mount in location on cross member. Make sure tab on mount is in position to engage hole in cross member. Install mount support plate on top of rubber mount.
2. Reposition mount near support plate and loosely install two screws with lock washers securing mount to support plate.
3. Raise car so that mount tab engages hole in cross member. Stud on left hand mount must fit in hole of cross member.
4. Secure mount to cross member at left hand side with nut or at right hand side with screw, lock and flat washers.
5. Torque two top side (mount-to-support) screws to 46 foot-pounds.
6. Torque lower nut or screw (mount-to-cross member) to 52 foot-pounds.
7. Remove stand and lower car.

116. Intake Manifold

a. Removal

1. Disconnect negative battery cable.
2. Remove carburetor air cleaner, heat tube and crankcase ventilating breather.
3. Disconnect carburetor and Cruise Control linkage at throttle adapter plate.
4. Disconnect wires from primary terminals of coil, and remove connector from S.C.S. solenoid.
5. Remove coil wire at coil tower and remove distributor cap and secondary ignition wires.
6. Disconnect single connector near ignition coil;

green wire to temperature sender.

7. Disconnect two orange wires from downshift switch. Disconnect anti-dieseling solenoid.

8. Remove ignition coil, anti-dieseling solenoid and S.C.S. solenoid with bracket from manifold.

9. Disconnect power brake vacuum hose and vacuum modulator hose from rear of carburetor.

10. Disconnect double connector from compressor clutch on cars equipped with air conditioning.

11. Disconnect air conditioning system vacuum hose from rear of manifold.

12. Remove fuel line between fuel pump and carburetor.

13. Disconnect distributor vacuum advance hoses at carburetor and position out of way.

14. On cars equipped with air conditioning, partially remove compressor as described in Section 1, Note 9a.

15. Disconnect PCV valve from right rocker arm cover.

16. Remove twelve screws securing manifold to cylinder heads and remove manifold.

17. Remove sheet metal manifold shield and gasket.

18. Remove rubber front and rear manifold to cylinder block gasket.

b. Installation

1. Place rubber seals over rails at front and rear of cylinder block. Tabs on gasket should be positioned in holes in rails and beveled ends of gasket tucked into slot at mating of head and rail.

2. Cement sheet metal gasket and shield on engine. Holes in gasket should engage dowel pins on cylinder heads.

3. Carefully position manifold on cylinder heads by lowering straight down. Secure manifold with twelve screws. Tighten to 30 foot-pounds.

4. Connect P.C.V. valve to right rocker arm cover.

5. On cars equipped with air conditioning, install compressor as described in Section 1, Note 9b.

6. Connect distributor vacuum advance hoses to carburetor.

7. Install ignition wires on spark plugs and install distributor cap.

8. Install fuel line between fuel pump and carburetor.

9. Connect power brake vacuum hose to fitting on rear of carburetor.

10. Connect vacuum modulator line to fitting at rear of carburetor.

11. On cars equipped with air conditioning, connect black and black/white wires to compressor clutch.

12. Connect single connector near coil; green wire to temperature sender.

13. Install coil, anti-dieseling solenoid and S.C.S. solenoid with bracket to manifold.

14. Connect primary wires to coil terminals and connect high tension lead to coil tower.

15. Install orange/black and orange/white wires to downshift switch. Connect anti-dieseling solenoid to wiring harness.

16. Connect Cruise Control and throttle linkage at throttle adapter plate.

17. Install carburetor air cleaner making sure heat tube engages heat shield on exhaust manifold.

18. Install Automatic Level Control, A.I.F. and Evaporative Loss Control hoses to air cleaner.

19. Check routing of all hoses around carburetor to make sure they do not interfere with the proper operation of the throttle linkage.

20. Connect negative battery cable.

21. Start engine and inspect for leaks.

117. Exhaust Manifold—Right or Left

a. Removal

1. If working on left manifold, remove carburetor air cleaner and heat duct. Remove nuts from #2 and #8 cylinder (#2 and #6 on Eldorado only) manifold studs and remove heat shroud from around manifold. (Remove dipstick tube on Eldorado.)

2. Remove two nuts securing header pipe to exhaust manifold at side being worked on.

3. Remove eight screws securing exhaust manifold to cylinder head.

4. Remove exhaust manifol from position in engine compartment.

b. Installation

1. Lubricate cylinder head mounting surfaces of the exhaust manifold with a thin coat of a moly-based lubricant (graphite).

2. Position manifold in location on cylinder head.

3. If working on left manifold, install screw/stud in front attaching hold of #2 cylinder and rear attaching hole of #8 cylinder (front hole of #2 and #6 on Eldorado only). Install six remaining screws. Torque all screws to 35 foot-pounds.

4. If working on right manifold, install eight screws securing exhaust manifold to cylinder head. Torque screws to 35 foot-pounds.

5. If working on left manifold, position heat shroud to exhaust manifold and secure with two nuts. (Install dipstick tube on Eldorado).

6. Move exhaust pipe into position at manifold and secure with two nuts.

7. If working on left manifold, install carburetor air cleaner making sure heat duct engages heat shroud on manifold.

118. Rocker Arm Covers

a. Removal

1. If working on left side, remove air cleaner, heat duct and crankcase ventilating breather. Remove ignition primary wiring harness from clips.

2. If working on right side, remove PCV valve and elbow from cover. Remove generator wiring harness from clips.

3. Remove spark plug cable, clips from studs (Fig. 6-127) and position out of way.

4. Remove seven screws and two screw studs holding cover to head and remove cover.

b. Installation

1. Using a new gasket, position cover on cylinder head and secure with nine screws. Screw/studs should be

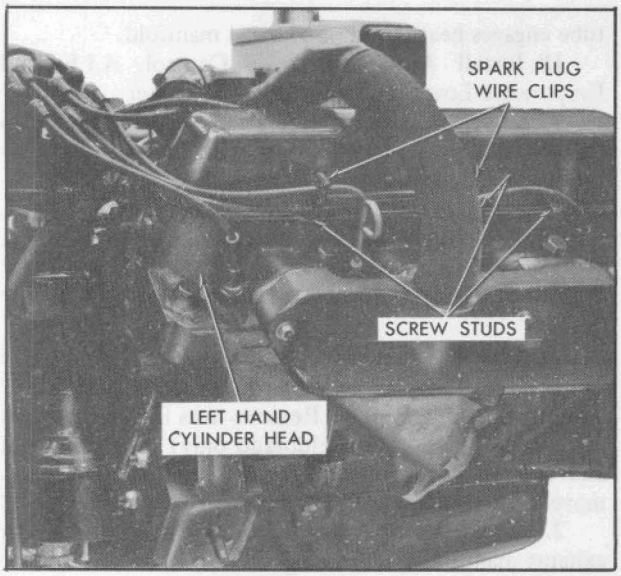


Fig. 6-127 Spark Plug Wire Clips

installed in locations shown in Fig. 6-127. Tighten screws to 30 in. lbs.

2. Position spark plug cable clips on studs, Fig. 6-127.

3. If working on right side, install PCV valve and elbow. Reposition generator wiring harness under clips.

4. If working on left side, install crankcase ventilating breather and air cleaner, making sure heat duct engages heat shroud on exhaust manifold. Reposition ignition primary wiring harness under clips.

119. Valve Lifters—Noisy Operation

Noisy operation of valve lifters may be due to:

a. Incorrect Oil Level in Crankcase

Oil level should never be above, nor more than a quart below "Full" mark on indicator. If level is too high, foaming may result, if too low, air may enter pump inlet. In either case, noisy valve action may result.

b. Improper Oil Pressure

If valve action is noisy after the oil is hot, it may be due to low oil pressure.

Low pressure usually results from an external leak in the engine lubrication system, a stuck or improperly operating oil pressure relief valve, scored parts, worn bearings, worn oil pump gears, clogged oil intake strainer screen assembly, or poor operation of oil pump.

c. Rusty or Varnished Valve Stems or Valve Guides

This condition may be associated with short trip operation, poor quality engine oil, or failure to change oil regularly.

d. Weak Valve Lifter Springs

These can cause noisy valve operation by causing sluggish plunger movements in the cylinder. To check these springs, disassemble plunger assembly, clean thoroughly and reassemble. Check pressure to compress spring with lifter dry.

If pressure required to compress spring 11/32 inch is less than 6-1/4 pounds, the assembly should be replaced.

e. Dirty, Worn, or Scored Valve Lifter Parts

A recurring tap or clock synchronized with valve action, indicates trouble in a single lifter assembly, which should be disassembled and checked for:

1. Dirt or foreign particles, which can be removed after disassembly by wiping with a soft cloth and washing in kerosene.

2. Varnish or heavy sludge material, which can be removed by the use of a proper solvent.

(NOTE: The engine oil pan should always be removed and cleaned when dirt has been responsible for sticking lifters. The oil passages from the header to the lifter bores should also be cleaned thoroughly by blowing out with kerosene and air.)

3. Pitting and scoring of surfaces, which may result from gritty particles, excessive wear, poor grade oil, or damage during installation. This condition requires replacement of the complete unit.

4. Incorrect clearance between cylinder and plunger, usually caused by mismating of parts. These parts are selectively fitted in manufacturing and are not interchangeable.

f. Lifters That Do Not Turn In Their Bores

Scoring, surface flaking, cupping or excessive wear on the bottom of the lifter may prevent the lifters from turning in their bores.

g. Other Causes

Excessive wear on either end of rocker arm or at rocker arm support; worn valve stems or push rods; worn camshaft lobes; air in suction side of oil pump system.

120. Valve Lifter Leak-Down Rate Checking

The Valve Lifter Leak-Down Rate Tester, J-3074, is used to obtain a comparison of leak-down rates of hydraulic valve lifters without removing them from the engine. With this tool, a feeler gage of a given thickness is placed between the rocker arm and the valve stem, causing valve spring pressure to force oil out of the lifter.

A spring, attached to the tool and compressed against the valve spring retainer, ejects the feeler gage when the lifter has leaked down enough to allow the valve to seat. By observing the length of time required by each lifter to leak-down the thickness of the feeler gage, a faulty lifter or lifters can be easily located.

Use the following procedure:

1. Operate engine to allow lifters to fill with oil.

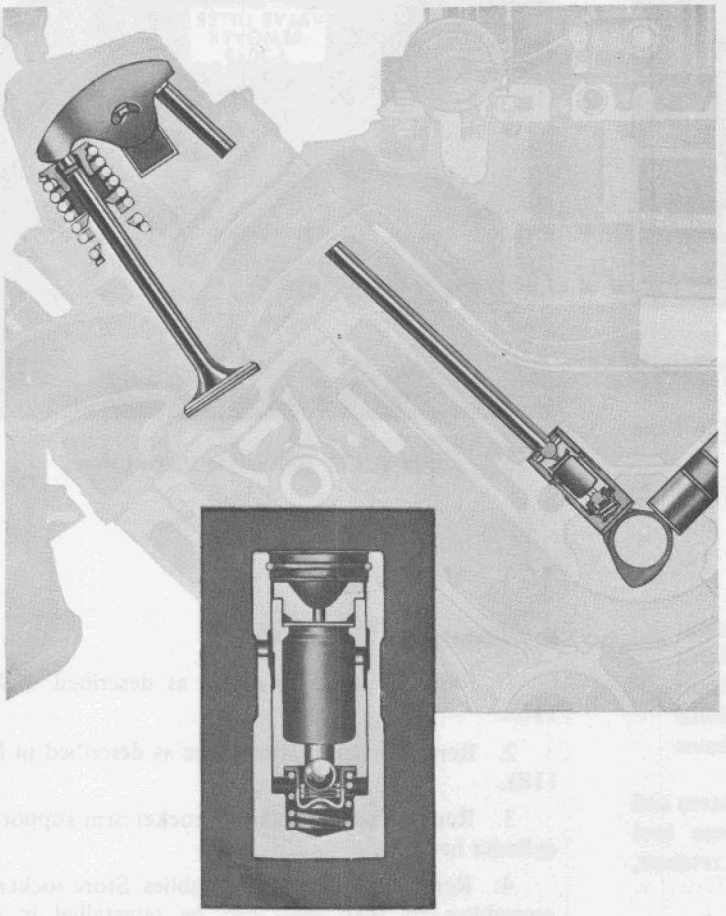
2. Turn off engine. Remove distributor cap and rotate crankshaft so that rotor is at No. 1 firing position.

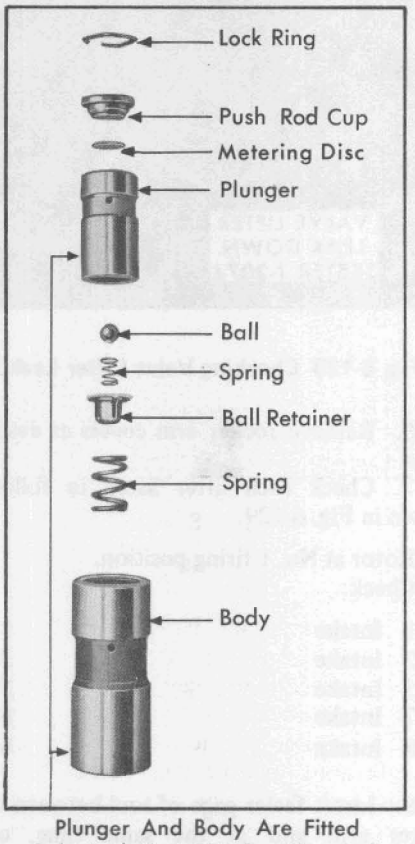
3. Remove carburetor air cleaner.

4. Disconnect negative battery cable.

5. Disconnect spark plug wires at plugs and remove wiring from tabs on rocker arm covers, but leave wiring connected.

ARRANGEMENT OF VALVES AND VALVE LIFTERS





Plunger And Body Are Fitted Pairs And Must Not Be Mismated.

OPERATION OF VALVE LIFTER MECHANISM

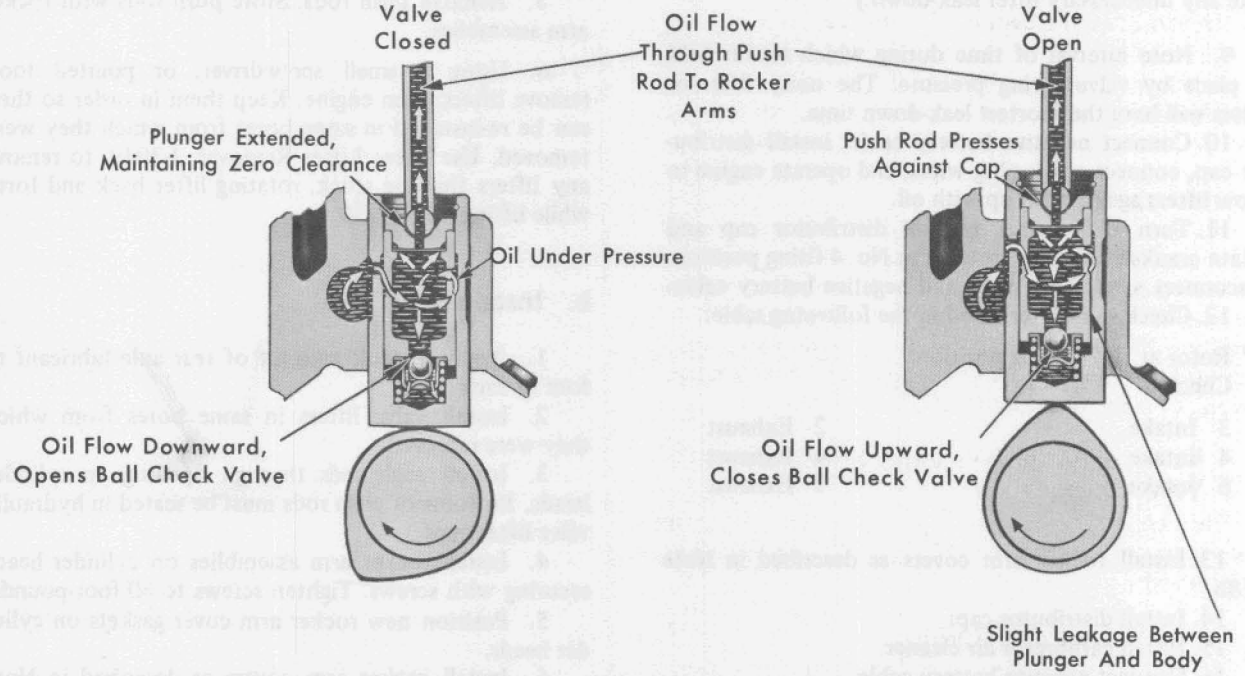


Fig. 6-128 Valve Lifter Mechanism

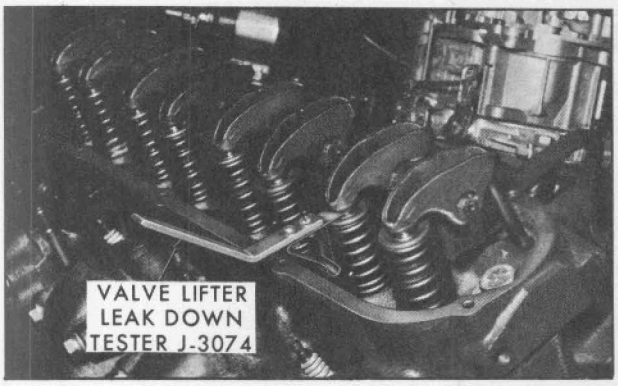


Fig. 6-129 Checking Valve Lifter Leak Down Rate

6. Remove rocker arm covers as described in Note 118a.

7. Check each lifter listed in following table as shown in Fig. 6-129.

Rotor at No. 1 firing position.
Check:

1 Intake	1 Exhaust
2 Intake	3 Exhaust
5 Intake	5 Exhaust
7 Intake	6 Exhaust
8 Intake	8 Exhaust

8. Insert feeler gage of tool between valve stem and rocker arm and at the same time, compress tool "popout" spring to its stock against valve spring retainer, Fig. 6-129.

(NOTE: Install tool as quickly as possible to eliminate any unnecessary lifter leak-down.)

9. Note interval of time during which tool is held in place by valve spring pressure. The noisy lifter or lifters will have the shortest leak-down time.

10. Connect negative battery cable, install distributor cap, connect spark plug wires, and operate engine to allow lifters again to fill up with oil.

11. Turn off engine, remove distributor cap and rotate crankshaft so that rotor is at No. 4 fiting position. Disconnect spark plug wires and negative battery cable.

12. Check each lifter listed in the following table:

Rotor at No. 4 firing position.
Check:

3 Intake	2 Exhaust
4 Intake	4 Exhaust
6 Intake	7 Exhaust

13. Install rocker arm covers as described in Note 118b.

14. Install distributor cap.

15. Install carburetor air cleaner.

16. Connect negative battery cable.

17. Operate engine to obtain operating temperature and re-torque rocker arm cover screws to 30 inch-pounds.

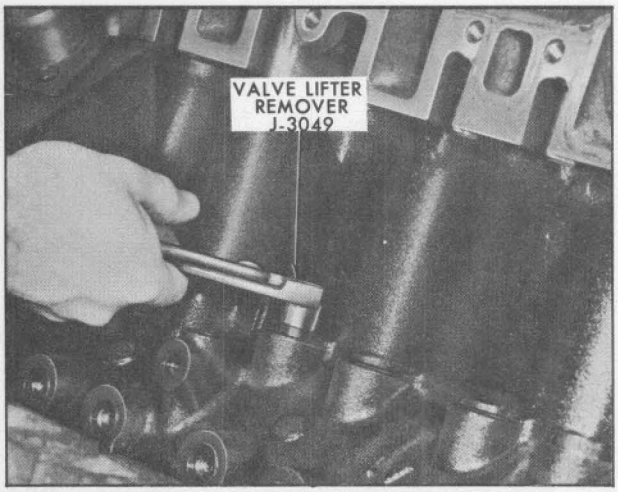


Fig. 6-130 Removing Valve Lifters

121. Valve Lifter

a. Removal

1. Remove intake manifold as described in Note 116a.

2. Remove rocker arm covers as described in Note 118a.

3. Remove screws securing rocker arm supports to cylinder heads.

4. Remove rocker arm assemblies. Store rocker arm assemblies so that they can be reinstalled in same location.

5. Remove push rods. Store push rods with rocker arm assemblies.

6. Using a small screwdriver, or pointed tool, remove lifters from engine. Keep them in order so they can be re-installed in same bores from which they were removed. Use Valve Lifter Remover, J-3049, to remove any lifters that are stuck, rotating lifter back and forth while lifting, Fig. 6-130.

b. Installation

1. Apply a small amount of rear axle lubricant to foot of each lifter.

2. Install valve lifters in same bores from which they were removed.

3. Install push rods through openings in cylinder heads. Bottoms of push rods must be seated in hydraulic valve lifter cups.

4. Install rocker arm assemblies on cylinder heads securing with screws. Tighten screws to 60 foot-pounds.

5. Position new rocker arm cover gaskets on cylinder heads.

6. Install rocker arm covers as described in Note 118b.

7. Install intake manifold as described in Note 116b.

122. Valve Lifter Disassembly and Assembly

a. Disassembly

(NOTE: Valve plungers and bodies are matched in pairs and are not interchangeable with one another. In order to fit properly, they must be reassembled to their original matching pairs.)

1. Press down on center of valve lifter push rod cup.
2. Using a pointed tool, remove lock ring from groove while holding cup down.
3. Invert lifter and slide out push rod cup, metering disk, plunger, ball, small spring, ball retainer and spring.

If plunger is stuck in lifter body, place lifter, push rod end down, in Valve Lifter Plunger Remover, J-4160, Fig. 6-131. Holding tool firmly in hand with thumb over lifter body, strike tool sharply on block of wood or wooden bench until plunger falls out of body.

b. Assembly

1. Place ball on its seat in lower end of plunger while holding plunger upside down. Place small spring on ball.
2. Position ball retainer over small spring and ball and snap into recess in plunger.
3. Place spring over ball retainer.
4. Lower lifter body over plunger assembly on an angle to seat spring.
5. Turn assembly right side up and fill plunger with clean engine oil.
6. Jiggle ball with small piece of wire until oil drains out of plunger into body and trapped air is released from body.
7. Refill plunger with oil, place oil metering disc and push rod cup on plunger, and position lock ring over cup.
8. Press lock ring into groove with Valve Lifter Lock Ring Installer, J-2730, Fig. 6-132.



Fig. 6-131 Removing Stuck Plunger From Body

123. Valve Spring Replacement

a. Removal

1. Remove carburetor air cleaner.
2. Remove rocker arm cover as described in Note 118a.
3. Remove rocker arm assembly from cylinder head.
4. Remove rocker arm supports.
5. Remove push rods.
6. Remove spark plug.
7. Connect air hose to Adapter J-22794 and supply air to cylinder.
8. Install rocker arm support screws.
9. Pass Valve Spring Compressor, J-22765-1, over rocker arm stand screw, Fig. 6-133.
10. Compress valve spring and remove locks from valve stem.

(NOTE: A sharp blow on a socket placed on top of the retainer will help break loose any stuck locks.)

11. Lift out nylon shedder spring retainer and spring, Fig. 6-134.
12. Clean gasket material off cylinder head and rocker arm cover.

b. Installation

1. Install valve spring nylon shedder and retainer, Fig. 6-134.
2. Using Valve Spring Compressor, J-22765-1, compress valve spring and install locks, Fig. 6-133.
3. Bleed air out of cylinder and remove air hose and Adapter, J-22794.
4. Install spark plug.

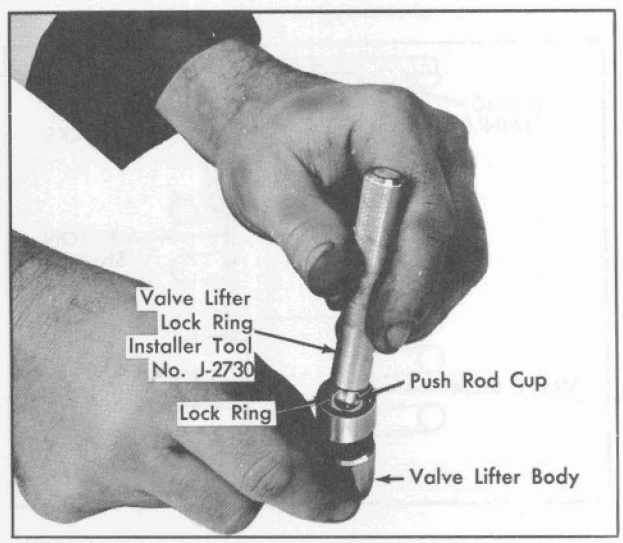


Fig. 6-132 Lock Ring Installation

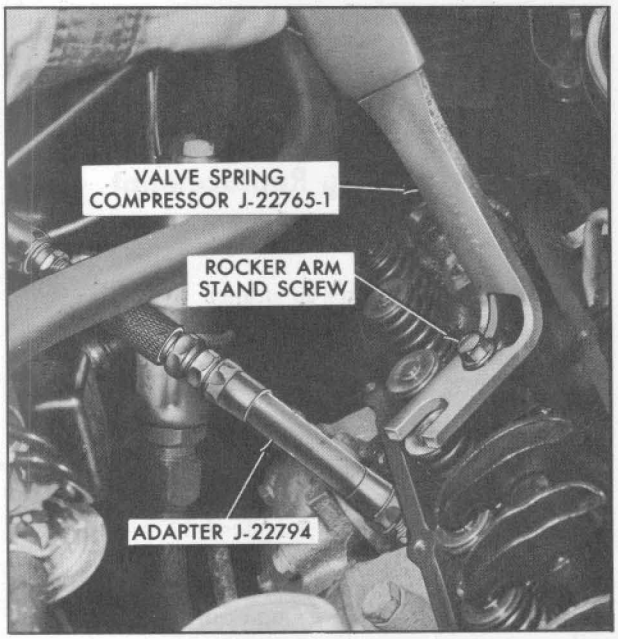


Fig. 6-133 Compressing Valve Spring

5. Remove rocker arm support screw.

6. Install push rods.

7. Position rocker arm on rocker arm supports, Fig. 6-135.

8. Position retainer on rocker arm supports.

9. Position rocker arm assembly on cylinder head and secure with screws. Tighten screws to 60 foot-pounds.

10. Position new rocker arm cover gasket on cover.

11. Install rocker arm cover as described in Note 118b.

12. Install carburetor air cleaner, making sure heat duct engages heat shroud on exhaust manifold.

13. Run engine and check for oil leaks.

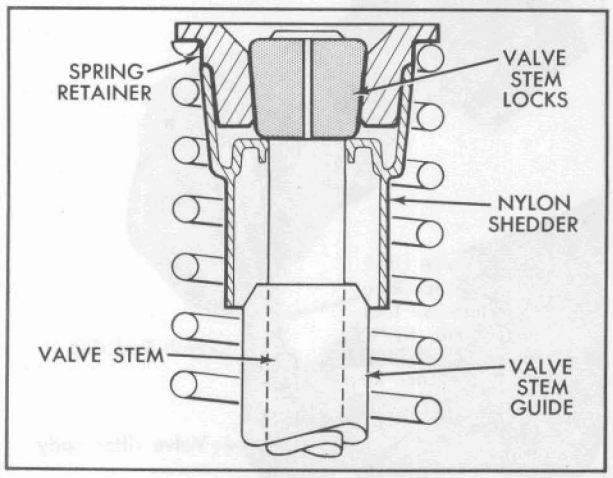


Fig. 6-134 Valve Spring Retainer

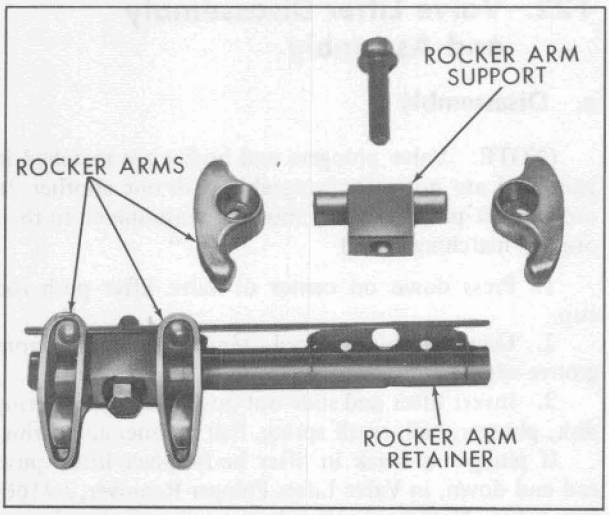


Fig. 6-135 Rocker Arms Disassembled

124. Cylinder Head

a. Removal

1. Drain cooling system.

2. Remove intake and exhaust manifolds as described in Notes 116 and 117 respectively.

3. Remove rocker arm covers as described in Note 118a.

4. Disconnect electrical and ground connections from cylinder head.

5. Remove generator as described in Note 61a if working on right cylinder head, or partially remove power steering pump as described in Section 9, Note 7a, if working on left cylinder head.

6. Perform Steps 3, 4 and 5 of Note 121a.

7. Install two 7/16-14 x 6" screws, to be used as lifting handles, in two of the rocker arm support screw holes.

8. Remove ten cylinder head screws and lift head from block.

9. Carefully remove all gasket material from mating surface of cylinder head and cylinder block and cylinder head and rocker arm cover mating surfaces.

b. Installation (Fig. 6-136)

1. Use extreme caution to insure that all mating surfaces of cylinder head and cylinder block are clean.

2. Position cylinder head gasket over dowels on cylinder block.

3. Position cylinder head on cylinder block.

4. Install ten cylinder head screws finger tight in locations as indicated in Fig. 6-136.

Bolt Location	Length
A (Bolt)	4.36" (Medium)
B (Bolt)	4.77" (Long)
C (Bolt)	3.02" (Short)
D (Bolt/stud)	4.77" (Long)

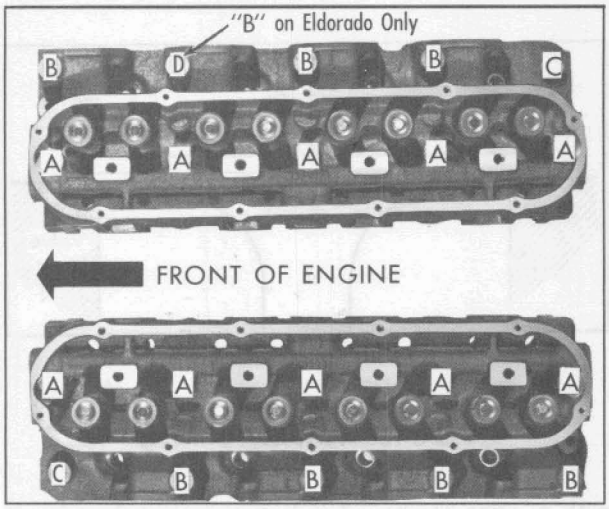


Fig. 6-136 Cylinder Head Screws

5. Tighten cylinder head screws to 155 foot-pounds starting from center of cylinder head and working toward both ends.

6. Remove two 7/16-14" x 6" screws used for lifting handles.

7. Install push rods through openings in cylinder head. Bottom of push rod must be seated in hydraulic valve lifter cup.

8. Position rocker arm assemblies on cylinder heads and secure with screws. Tighten screws to 60 foot-pounds, Fig. 6-136.

9. Install rocker arm cover as described in Note 118b.

10. Install exhaust and intake manifolds as described in Notes 116 and 117 respectively.

11. Install generator as described in Note 61b if working on right cylinder head, or power steering pump as described in Section 9, Note 7b if working on left cylinder head.

12. Connect high temperature warning wiring connector to sending unit at rear of left cylinder head.

13. Refill cooling system.

14. Operate engine to normal operating temperature and re-torque rocker arm cover screws. Check for coolant and oil leaks.

125. Valve (Intake or Exhaust)

a. Removal

1. Remove cylinder heads as described in Note 124a.

2. Set cylinder head on clean work bench. Position cylinder head on intake manifold surface.

3. Position valve spring compressor over valve, Fig. 6-137 and compress valve spring.

4. Remove valve locks.

5. Slowly release tension on valve spring compressor and remove compressor.

6. Remove valve spring retainer, spring and oil shedder from cylinder head. Discard oil shedder.

7. Remove valve from cylinder head.

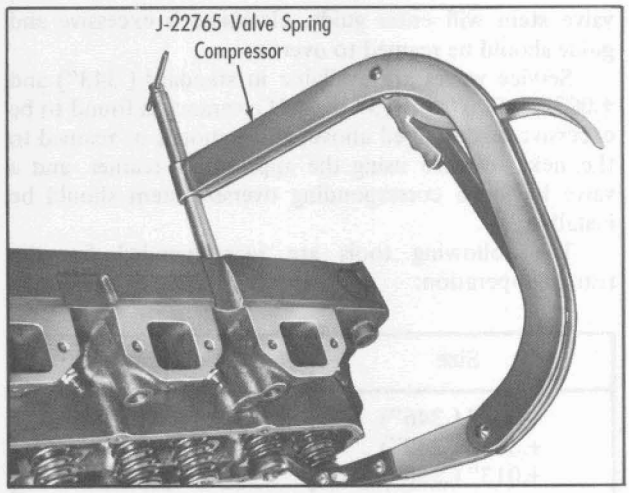


Fig. 6-137 Removing Valve

8. Repeat steps 3 through 7 for remaining valves to be serviced.

b. Installation

1. Position valve into cylinder head.

2. Position new valve spring retainer and new valve spring oil shedder on valve stem.

3. Engage valve and retainer with valve spring compressor, Fig. 6-137 and compress valve spring.

4. Install valve locks on valve stems.

5. Slowly release tension on valve spring compressor and remove valve spring compressor.

6. Repeat steps 1 through 5 for remainder of valves to be installed.

7. Install cylinder head on engine as described in Note 124b.

126. Valve and Seat Reconditioning

Valve reconditioning is normally required less frequently in engines having hydraulic valve lifters. When this work is done, the close limits given in the engine specifications, Page 6-126 thru 6-127 must be maintained.

Check valve stem to guide clearance using a hole gage and an outside micrometer. Measure valve guide inside diameter with hole gage, crossways to engine, at both top and bottom of guide, measuring gage each time with micrometer. A standard size valve guide is .343" in diameter.

Measure valve stem diameter with micrometer and subtract from greater of two guide measurements to obtain maximum clearance. If clearance is greater than .005 inch, guide should be reamed to oversize to prevent excessive oil consumption and improper seating of valves.

An alternate method of checking valve stem to guide clearance, if a hole gage is not available, is by using a 1/16 inch wide strip of .005 inch brass shim stock on a "no-go" basis.

Bend end of shim and hang in end of valve guide, with tip extending towards push rod side of head. Shim should not extend more than 1/4 inch into guide. If

valve stem will enter guide, clearance is excessive and guide should be reamed to oversize.

Service valves are available in standard (.343") and +.003", +.006", + .013" sizes. If clearance is found to be excessive as described above, guide should be reamed to the next oversize using the appropriate reamer, and a valve having a corresponding oversize stem should be installed.

The following tools are recommended for the reaming operation:

Size	Tool Number
+.003" (.346")	J-5830-1
+.006" (.349")	J-5830-6
+.013" (.356")	J-5830-7

Valves with a .003" oversize diameter and .003" oversize valve guides are installed at the factory on some engines. Engines so fitted will be marked by a "3" stamped on the cylinder head gasket surface in line with the oversize valve.

All oversize service valves will be so marked on the valve head so that they may be easily identified when part numbers are not available.

When an oversize valve is installed, be sure to stamp the oversize marking on the cylinder head gasket surface, as explained above, for future reference.

Check concentricity of all valve seats. This should be within .004 inch total, as measured with dial indicator and a solid, slightly tapered pilot which has a slight bind in the valve guide when installed.

CAUTION: A pilot of the correct size must be used. Do not attempt to drive pilot into guide. Pilots with adjustable diameters to fit various sized guides are not recommended.

Grind valve seats to within .002 inch indicator reading when new valves are being installed, or if concentricity, seat width, or full contact of valves is not as specified.

Check seat width and location on valve to insure proper heat dissipation and prevent build up of carbon on seats. Condition valve seat to a width of 3/64 to 1/16 inch. This seat width will insure good idle stability.

Valve seats should be cut on a 45° angle so that the seat is 1/16 inch smaller in diameter than the valve head, Fig. 6-138, to allow heat to escape and to provide maximum life for newly ground valves. The diameter of the seat can be checked by placing valve in position and then rotating to get a contact pattern with the seat.

New valves have a face angle of 44° to provide a line contact between the head of the valve and the valve seat in the cylinder head, which assures good seating of the valve and less chance of burning the valve head due to exhaust gas leakage. When reconditioning valves, always grind valve face angle to 44°.

Service valves should not have more than 1/64 inch wide contact with valve seats (due to 1° difference in angle) and should not be ground as they are ready to use just as you receive them. Grinding of valves by hand with grinding compound or lapping to seat them is not recommended. Use only precision equipment for valve and seat reconditioning, and follow equipment manufacturer's instructions.

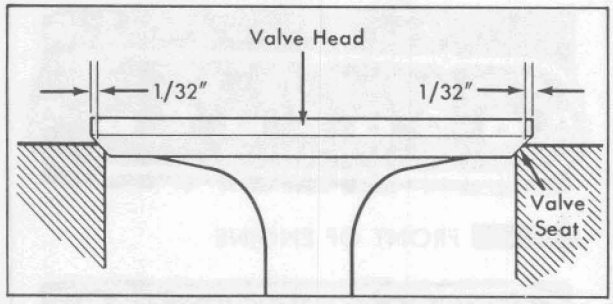


Fig. 6-138 Valve Seat Grinding

127. Engine Oil Pan

a. Removal

1. On 693 cars drain oil, remove engine from vehicle chassis as described in Note 113a and proceed with steps 9 and 10.
2. Disconnect negative battery cable.
3. Drain engine oil.
4. Remove exhaust "Y" pipe at exhaust manifold as described in Section 8, Note 11a.
5. Remove starter motor as described in Note
6. Remove two idler arm support mounting screws and lockwashers from frame side member, and lower support.
7. Disconnect pitman arm at center link, using Puller, J-8990, and lower steering linkage.
8. Remove transmission lower cover.
9. Remove nuts and cap screws that hold oil pan to cylinder block and remove oil pan.
10. Remove side gaskets and rubber front and rear seals from oil pan, and discard.

b. Installation

1. Cement new gasket to both sides of oil pan, with gasket cement lining up holes in gaskets with holes in oil pan flange.
2. Thoroughly clean front and rear seal surfaces of oil pan, and install new oil pan front and rear seals by pulling locating tangs on seals through locating holes in seal flange. Make sure seals are firmly positioned on flange surfaces with ends of each seal properly located in cut-out notches in side gaskets.
3. Seal all four corner notch openings with a coating of gasket cement.
4. Clean out notches in block where ends of oil pan rear seal fit. Fill this rectangular cavity with Transmission Cooler Hose Cement.

(NOTE: This cement will be easier to apply if the tube has been stored in a cool location to prevent the

contents from becoming too thin.)

5. Position oil pan on bottom surface of cylinder block and install cap screws and nuts tightening to 10 foot-pounds.

6. On 693 cars install engine as described in Note 113b and proceed with step 12.

7. Install transmission lower cover and secure with four cap screws. Tighten screws to 20 foot-pounds.

8. Connect pitman arm to center link.

9. Secure idler arm support mount to frame with two attaching screws and lockwashers. Tighten screws to 35 foot-pounds.

10. Secure starter motor to cylinder block as described in Note 28b.

11. Install exhaust "Y" pipe as described in Section 8, Note 11b.

12. Add four quarts engine oil to crankcase. Use five quarts on Eldorado. Check oil dipstick for proper oil level.

13. Connect negative battery cable.

14. Run engine and check for leaks at all connections.

128. Oil Pump Servicing

a. Removal

1. Raise car.
2. Remove oil filter.
3. Remove five screws securing oil pump to engine. The screw nearest the pressure regulator should be removed last, allowing the pump to come down with screw. Discard oil pump to crankcase gasket.
4. Remove pump drive shaft.

b. Disassembly

1. Slide drive shaft, drive gear and driven gear out of pump housing.
2. Using a 5/16 inch hex head wrench, remove plug from pump housing assembly, and remove oil pressure regulator valve and spring from bore in housing assembly.

c. Inspection

1. Inspect oil pressure regulator valve for nicks and burrs that might cause a leak or binding condition in bore of pump housing.
2. Check free length of regulator valve spring. It should be approximately 2.57 inches to 2.69 inches in length. A force of 7-1/2 to 8-1/2 pounds should be required to compress the spring to 1-7/16 inches.
3. Inspect drive gear and driven gear for nicks and burrs.
4. Inspect pump housing for wear and score marks.
5. Check pump mating surfaces on engine block for wear and score marks.

d. Assembly

1. Install oil pressure regulator valve and spring in bore of pump housing assembly.
2. Using a 5/16 inch hex head wrench, install plug in housing assembly and tighten plug to 30 foot-pounds.
3. Install pump drive gear over lower shaft in pump housing.
4. Slide driven gear over remaining shaft in pump housing, meshing driven gear with drive gear.

(NOTE: The hex markings on both gears should be installed upwards toward the crankcase.)

e. Installation

1. Pack pump with petrolatum.
2. Position new gasket on pump housing.
3. Engage pump drive shaft with distributor drive and guide into oil pump drive gear.
4. Install pump to engine by allowing it to ride up as screw nearest pressure regulator is turned in.
5. Install remaining four screws. Tighten all five screws to 15 foot-pounds.
6. Install oil filter and add 1 quart engine oil to crankcase.
7. Run engine and check for leaks in pump area.
8. Lower car.

129. Rear Main Bearing Oil Seal Replacement

Rear main bearing seal installation can be properly accomplished by using a simple, easily made tool, Fig. 6-139. Make the tool out of a metal banding strap or shim stock. The tool will act as a "shoehorn" to protect the backbone or outer diameter of the seal from scraping against the sharp edge of the cylinder block. Replacement procedure is as follows:

1. Disconnect spark plug wires and remove spark plugs.
2. Raise car.
3. Remove oil pan as described in Note 127a.
4. Loosen two screws that hold rear main bearing cap to cylinder block and remove cap with screws.
5. Remove lower seal half from bearing cap and discard.
6. Rotate upper seal half by pushing on one end with sharp object, and remove upper seal half from cylinder block.
7. Inspect grooves in bearing cap and cylinder block to be sure they are clean, dry and free from burrs.

(NOTE: The two seal halves are identical and can

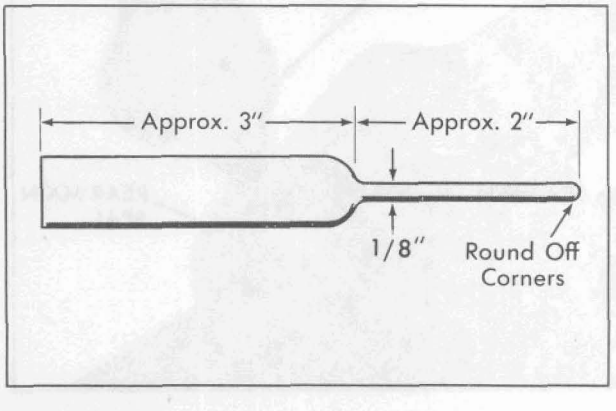


Fig. 6-139 Main Bearing Oil Seal Tool

be used in either the lower or upper location. Both seal halves are pre-lubricated with a film of wax for break-in. Do not remove or damage this film.)

8. To install lower half of seal into the bearing cap, slide either end of seal into position at one end of bearing cap and place tool in groove at other end of bearing, Fig. 6-140. Make sure the seal is positioned in the groove and the lip of the seal is facing forward (car position).

9. Hold thumb or finger over end of seal that is flush with split line to prevent it from slipping upward, and push seal into seated position by applying pressure to the other end.

10. Make sure seal is pressed down firmly and is flush on each side to avoid possibility of a leak at the seal split line. Avoid pressing on lip as damage to sealing edge could result.

11. To install upper half of seal in cylinder block (with crankshaft in car), position "shoehorn" in groove of block. Lubricate seal and start into groove in block with lip facing forward. Rotate seal into position, using care not to distort it, Fig. 6-140.

12. Do not press on lip or sealing edge of seal may be damaged. Also, both ends of seal should be flush at the seal split line to avoid leaks.

13. If necessary, Lubriplate, or its equivalent, may be used to facilitate installation of both lower and upper half of seal. Do not use silicone or an oil leak may result.

14. Install bearing cap and secure with attaching screws. Tighten screws to 95 foot-pounds.

15. Rotate crankshaft 360° to make sure crankshaft is not binding.

16. Install oil pan as described in Note 127b.

17. Install spark plugs and tighten to 25 foot-pounds. Connect spark plug wires.

18. Run engine and check for oil leaks.

19. Lower car.

130. Harmonic Balancer

a. Removal

1. Disconnect negative battery cable.
2. Drain coolant from radiator.
3. Loosen hose clamp at radiator inlet (top) and remove one screw securing hose retainer at radiator cradle. Position upper radiator hose out of way.
4. Remove fan blade assembly as described in Note 8a.
5. Remove generator belt and power steering pump belts.
6. Remove four cap screws that hold crankshaft pulley to harmonic balancer and remove pulley and balancer.
7. Remove plug from end of crankshaft.
8. Install Harmonic Balancer Puller Pilot, J-21052-4, in bore in end of crankshaft, Fig. 6-141.
9. Install Holding Base, J-21052-1, on front of hub, lining up holes on base with screw holes in hub, and install four holding screws with washers finger tight, Fig. 6-142. Do not use a wrench to tighten screws.

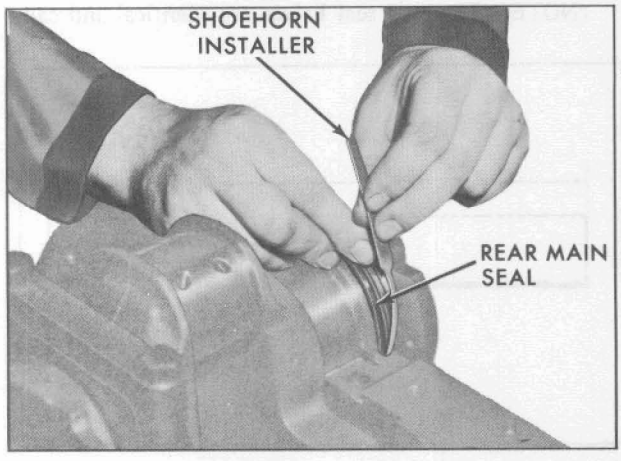


Fig. 6-140 Installing Rear Main Oil Seal

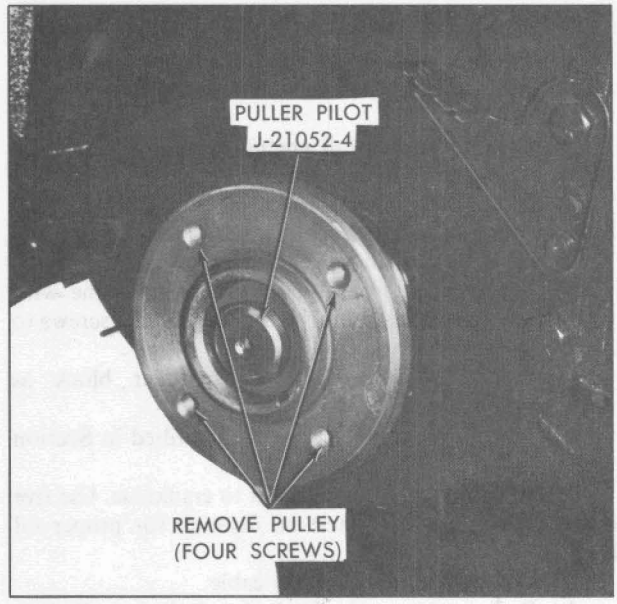


Fig. 6-141 Installing Balancer Hub Pilot

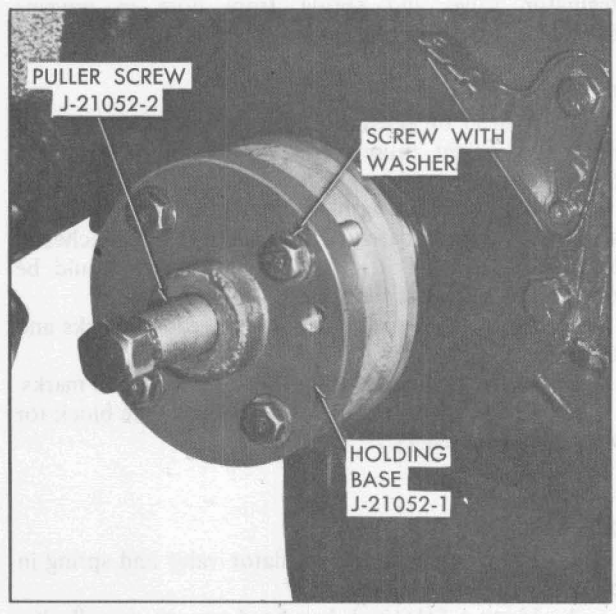


Fig. 6-142 Removing Balancer Hub

(NOTE: The base will bolt to the hub in only one position. Do not install screws if they must be slanted.)

10. Thread Puller Screw, J-21052-2, into base unitl screw contacts pilot.

11. Using a wrench, remove hub from crankshaft by tightening screw, Fig. 6-142.

(NOTE: Use of shop air pressure to hold one piston within its compression stroke may be necessary to remove hub without turning the crankshaft. Remove a spark plug, install Adapter J-22794, in spark plug port, and apply air pressure to hold piston within its compression stroke.)

12. Remove pilot from end of crankshaft and remove Harmonic Balancer Puller from harmonic balancer.

b. Installation

1. Lubricate bore of hub and seal with E.P. lubricant to prevent seizure to crankshaft.

2. Position hub on crankshaft, lining up to key slot in hub with key on crankshaft.

3. Place Holding Base, J-21052-1, against front face of pulley and thread Installer Screw, J-21052-5, into end of crankshaft. Position thrust bearing with inner race forward, washer next, and Installer Nut, J-21052-6, last, Fig. 6-143.

4. Using a wrench, install hub on crankshaft by tightening screw.

(NOTE: Use of shop air pressure, as explained in removal procedure, may be necessary to install hub assembly without turning crankshaft.)

5. When harmonic balancer assembly is positioned on crankshaft, remove Harmonic Balancer Remover and Installer. Do not try to install harmonic balancer all the way with this tool, or tool will be damaged. Thread a 1962 harmonic balancer-to-crankshaft screw and washer in end of crankshaft. Tighten screw to 125 foot-pounds.

6. Install four pulley to harmonic balancer screws that were previously removed and tighten all four screws to 15 foot-pounds.

(NOTE: Hole in balancer and hub will line up only in one position.)

7. Remove screw and washer from end of crankshaft, and install plug.

8. Exhaust air pressure from cylinder, remove Adapter, J-22794, and install spark plug.

9. Install pulley and fan blade assembly on water pump as described in Note 8b.

10. Install power steering pump belt and generator drive belts on pulleys.

11. Adjust all belts as described in Note 10.

12. Connect upper radiator hose at radiator inlet pipe and secure with hose clamp. Secure hose retainer to radiator cradle with one screw.

13. Lower car.

14. Refill cooling system with coolant.

15. Reconnect negative battery cable.

16. Run engine to check for coolant and oil leaks.

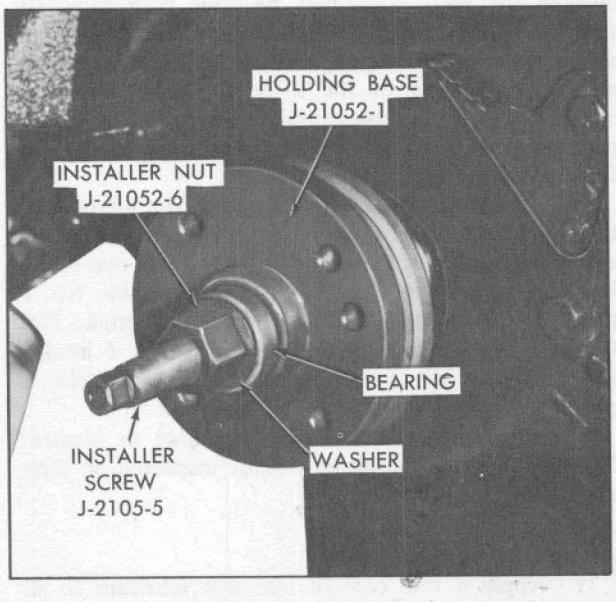


Fig. 6-143 Installing Balancer Hub

131. Engine Front Cover

a. Removal

1. If working on Eldorado, remove engine from vehicle chassis as described in Note 113a.

2. Remove harmonic balancer as described in Note 130a.

3. Drain oil from oil pan.

4. Remove oil pan as described in Note 127a.

5. Loosen hose clamp at water pump inlet and remove lower radiator hose from water pump.

6. Remove 10 screws that hold front cover to cylinder block and remove cover with water pump attached. Discard gasket.

b. Installation

1. Position new front cover gasket over locating dowels on cylinder block.

(NOTE: Apply a small amount of gasket cement to hold gasket in place.)

2. Install front cover, with water pump attached, over end of crankshaft, lining up dowel holes in cover with locating dowels on cylinder block. Secure with attaching screws. Refer to Fig. 6-144 for proper screw location and torque specifications.

3. Install harmonic balancer as described in Note 130b.

4. Install oil pan as described in Note 127b.

5. If working on Eldorado, install engine in vehicle chassis as described in Note 113b.

6. Install lower radiator hose to water pump inlet and secure with hose clamp.

Key	(No.)	Size	Torque
A	(4)	3/8-16 x 1-3/8	22 Foot-Pounds
C	(3)	5/16-18 x 1-1/4	10 Foot-Pounds
D	(1)	5/16-18 x 5/8	10 Foot-Pounds
E	(2)	3/8-16 x 5/8	22 Foot-Pounds

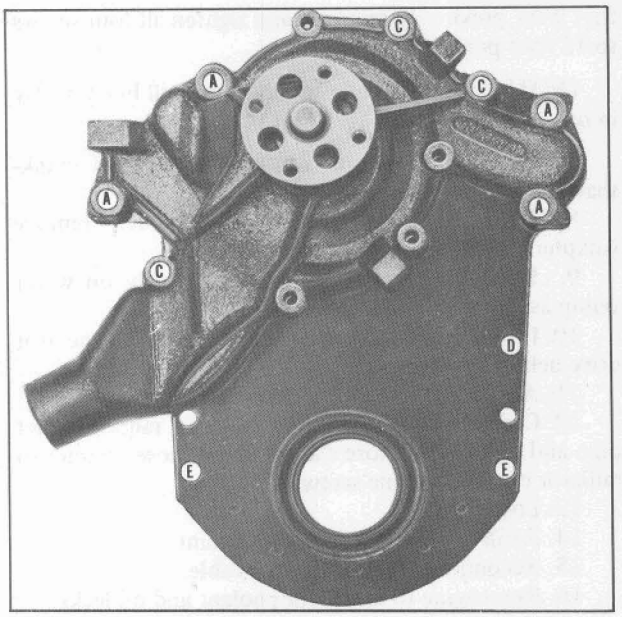


Fig. 6-144 Engine Front Cover Attaching Screws

7. Refill cooling system and crankcase as described in Notes 6 and Section 0, Note 2c, respectively.
8. Run engine and check for leaks.

132. Front Cover Oil Seal Replacement (Fig. 6-145)

a. Removal

1. Remove harmonic balancer as described in Note 130a.
2. With thin-bladed screwdriver or similar tool, pry out front cover oil seal. Discard seal.

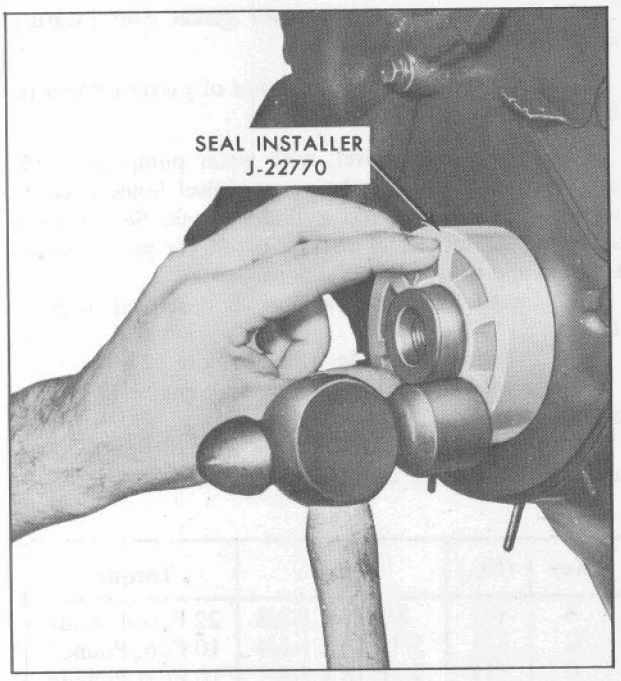


Fig. 6-145 Installing Front Cover Oil Seal

b. Installation

1. Lubricate new oil seal by filling the cavity between the lips with wheel bearing grease. Position seal on end of crankshaft with garter spring side toward engine.
2. Using Seal Installer, J-22770, and hammer, drive seal into front cover until it bottoms against front cover, Fig. 6-145.
3. Install harmonic balancer as described in Note 130b.

133. Camshaft

a. Removal

1. Remove engine front cover as described in Note 131a.
2. Remove ignition distributor as described in Note 33a.
3. Remove oil pump as described in Note 128a.
4. Remove oil slinger from crankshaft.
5. Remove fuel pump as described in Note 93a.
6. Remove screw securing fuel pump eccentric to camshaft and remove eccentric.
7. Remove two screws securing camshaft sprocket to camshaft.
8. Remove camshaft sprocket with chain attached.
9. Remove valve lifters as described in Note 121a.
10. Remove radiator as described in Section 13, Note 1a.
11. Slide camshaft forward carefully until it is out of engine.

CAUTION: Extreme care must be exercised to keep cam lobes from scratching camshaft bearings.

b. Inspection

The camshaft is made of alloy cast iron. It must be handled with particular care to avoid damage.

Whenever camshaft has been removed from engine, or faulty camshaft action is suspected in diagnosing engine conditions, the camshaft lobes should be visually checked for wear. This may be done with camshaft installed in engine, by removing hydraulic lifters and noting condition of camshaft lobes. Excessive wear, scoring, or flaking of the lifter will usually denote camshaft wear. Excessive camshaft wear is evidenced by grooves, scoring or flaking. Camshaft should be replaced if any of these conditions exist.

The camshaft lifts the intake valves to a lift of .440 inch. Exhaust valves have a lift of .454 inch. The intake and exhaust lobes are arranged from front to rear in the following order: No. 1 exhaust, No. 2 intake, No. 1 intake, No. 2 exhaust, No. 3 exhaust, No. 4 intake, No. 3 intake, No. 4 exhaust, No. 5 exhaust, No. 6 intake, No. 5 intake, No. 6 exhaust, No. 7 exhaust, No. 8 intake, No. 7 intake, and No. 8 exhaust.

Bearing journals should not be scored or burned. Camshaft bearings should be visually inspected, in their bores, for excessive wear.

c. Installation

1. Apply a thin coat of rear axle lubricant to all camshaft lobes and bearing journals.

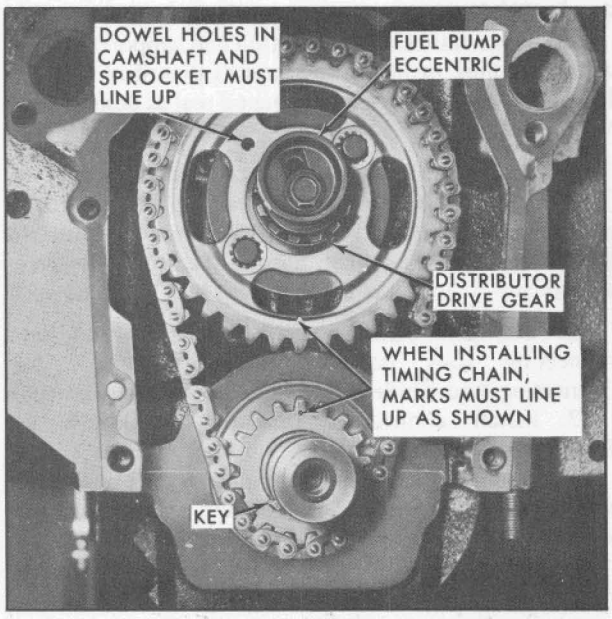


Fig. 6-146 Timing Sprockets

2. Guide camshaft carefully into cylinder block.

CAUTION: Extreme care must be exercised to avoid nicking or scratching camshaft bearings.

3. Install valve lifters as described in Note 121b.
4. Install camshaft sprocket in timing chain with timing mark toward front.
5. Place chain over crankshaft sprocket and line up timing marks on both sprockets, Fig. 6-146.

(NOTE: Engine is being timed so that cylinder #4 is in the firing position.)

6. Hold camshaft sprocket in position against end of camshaft and press sprocket on camshaft by hand, being sure index hole in camshaft is lined up with index hole in sprocket.
7. Install two screws and lockwashers securing camshaft sprocket to camshaft. Tighten screws to 18 foot-pounds.
8. Install fuel pump eccentric on camshaft and secure with screw. Tighten screw to 35 foot-pounds.
9. Install fuel pump as described in Note 93b.

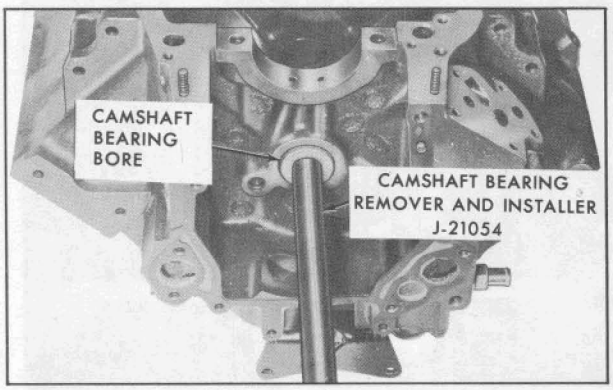


Fig. 6-147 Removing Camshaft Bearings

10. Install oil slinger on crankshaft with smaller end of slinger against crankshaft sprocket.
11. Install engine front cover as described in Note 131b.
12. Install ignition distributor as described in Note 33b.

(NOTE: Engine timing has been set so that cylinder #4 is in the firing position. When installing the distributor, either set the rotor so that cylinder #4 is firing or crank the engine 180° and set ignition timing on cylinder #1.)

13. Install oil pump as described in Note 128b.
14. Install radiator as described in Section 13, Note 1b.

134. Camshaft Bearing Replacement

Babbitt type camshaft bearings are used on all engines. Whenever camshaft has been removed from engine for inspection, these bearings should be visually inspected in their bores for excessive wear. If excessive wear is evident, all five bearings should be replaced. A precision pre-machined camshaft bearing, interchangeable bore to bore, is available for field replacement.

a. Removal

1. Remove camshaft as described in Note 133a.
2. Thread Arbor, J-21054-2 on end of Drive Shaft, J-21054-1, and position shoulder on arbor against front face of No. 1 bearing, Fig. 6-147.
3. Using a hammer, drive out No. 1 bearing through rear face of bearing bore. Remove bearing from arbor and discard.
4. Remove remaining four bearings in same manner. When removing No. 5 bearing, drive out rear cup plug, located behind No. 5 bearing, along with bearing.

b. Installation

1. Install new cup plug in rear of No. 5 bearing bore and seal plug with a permanent type sealer.
2. Locate center oil passage in each bearing bore and scribe a reference mark on front face of each bore, Fig. 6-148.
3. Slide Drive Shaft, J-21054-1, with Arbor, J-21054-2, through No. 1, 2, 3 and 4 bearing bores until arbor is positioned between No. 4 and No. 5 bores.
4. Place new bearing on Arbor and position in No. 5 bearing bore, lining up oil hole in bearing with scribe mark on front face of bore, Fig. 6-149.
5. Using a hammer, install bearing in bore until oil hole in bearing is lined up with oil passage in bore.
6. Install No. 4, 3, 2 and 1 bearings in the same manner.
7. Install camshaft as described in Note 133b.

135. Crankshaft

a. Removal

1. If working on Eldorado, remove engine from vehicle chassis as described in Note 113a. Proceed to

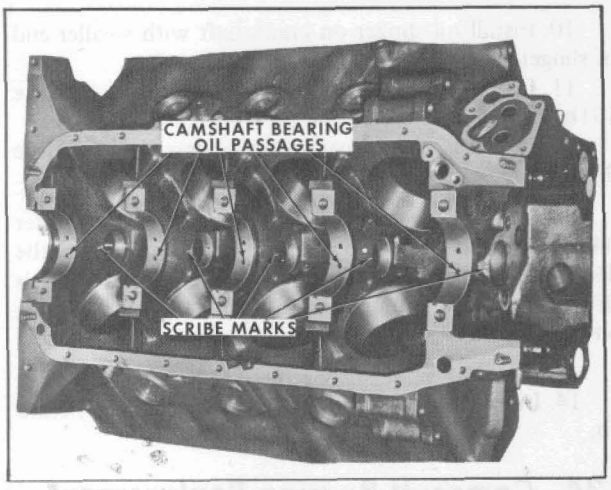


Fig. 6-148 Camshaft Bearing Oil Passages

Step 3.

2. Raise car.
3. Remove oil pan as described in Note 127a.
4. Remove timing chain and sprockets as described in Note 133a steps 1 through 8.
5. Remove screws and nut securing oil pick-up tube and strainer assembly to cylinder block and remove intake screen assembly. Discard O-ring.
6. On all cars except 693 remove transmission as described in Section 7, Note 12a. On Eldorado, remove transmission from engine.
7. Remove six screws that hold flywheel to crankshaft and remove flywheel.
8. Remove spark plugs.
9. Disconnect connecting rods and, using Connecting Rod Guide Set, J-3224, to protect journals, push pistons up into cylinders so that crankshaft can be removed without interference.
10. Remove front and rear main bearing caps.
11. Support crankshaft at front and rear and remove three intermediate bearing caps.
12. Remove crankshaft from engine.

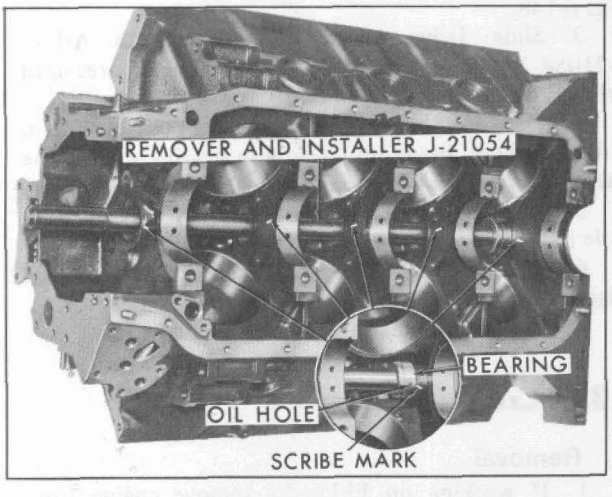


Fig. 6-149 Installing Camshaft Bearings

b. Installation

1. Place crankshaft in position and support in place while installing main bearing caps as described in Note 143. Use a new rear main bearing oil seal as described in Note 129.

(NOTE: Each bearing cap has a number of dimples (1, 2, 3, 4) machined on bottom starting from the front of the engine as shown in Fig. 6-150. Do not mismatch these caps or turn them around because they are individually matched as the cylinder block is machined.)

2. Lubricate crankpins with engine oil and pull connecting rods down toward crankshaft. Use Connecting Rod Guide Set, J-3224, to protect journals.
3. Install connecting rods on crankshaft as described in Note 136.
4. Install oil pick-up tube and strainer assembly with new O-ring on cylinder block and secure with two screws and nut. Tighten to 18 foot-pounds.
5. Install flywheel and secure with six screws. Tighten screws to 75 foot-pounds.
6. On all cars except Eldorado, install transmission as described in Section 7, Note 12b. On Eldorado, install transmission to engine.
7. Install spark plugs. Tighten to 25 foot-pounds.
8. Install timing chain and sprockets as described in Note 133b.
9. Install oil pan as described in Note 127b.
10. Lower car.
11. If working on Eldorado, install engine in vehicle chassis as described in Note 113b.

136. Connecting Rod and Piston

a. Removal

1. If working on Eldorado, remove engine from vehicle chassis as described in Note 113a.
2. Remove cylinder heads as described in Note 124a.
3. Clean carbon from top of cylinder bore. Ream upper ridges if necessary to prevent breakage or distortion of piston ring lands due to rings catching in the

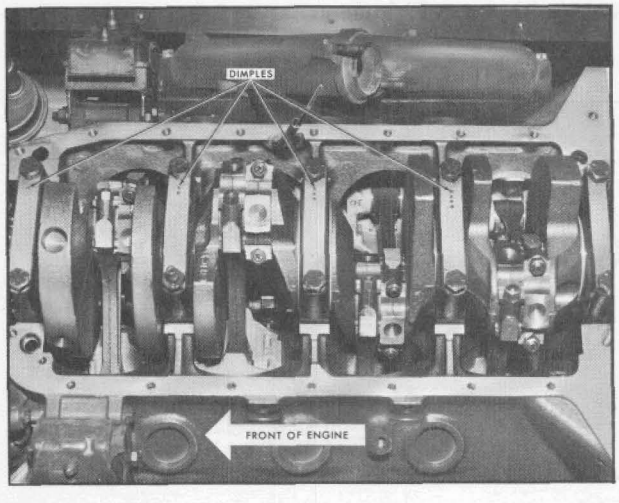


Fig. 6-150 Main Bearing Caps

ridge. Pack cylinder bore with cloth to catch shavings.

4. Remove oil pan as described in Note 127a.

5. Remove two cap screws and nut that hold oil pick-up tube and strainer assembly to cylinder block. Discard O-ring.

6. Remove connecting rod cap by removing connecting rod nuts and sliding cap down off connecting rod bolts, Fig. 6-151.

7. Install Connecting Rod Guide Set, J-3224, on connecting rod bolts.

CAUTION: Be careful not to damage crankshaft or cylinder bore when removing piston and rod assembly.

8. Push connecting rod and piston assembly up until piston rings are out of bore, and remove piston and connecting rod assembly from engine.

CAUTION: Be careful not to nick lower edge of bore when pushing rod up.

9. Remove remaining seven piston and connecting rod assemblies in same manner.

b. Installation

(NOTE: Refer to Note 140 for piston identification between 472 and 500 cubic inch engines.)

1. Removing connecting rod cap from connecting rod and install bearing inserts in both cap and rod, being careful to locate bearings tangs in locating notches.

2. Install Connecting Rod Guide Set, J-3224, on rod bolts to protect crankpin journals.

3. Using Piston Ring Compressor, J-22748, position capless rod and piston in cylinder bore with arrow in trough pointing toward front of engine (letter "R" on piston toward rear) Fig. 6-152.

4. Using wood hammer handle, tap piston and connecting rod down into position on crankpin and remove Connecting Rod Guide Set, J-3224.

CAUTION: Extreme care must be exercised when installing pistons and rods to be sure rod is lined up with crankshaft journals and does not stick or bind on counterweights.

5. Install connecting rod cap with bearing in place, over connecting rod bolts, making sure numbered side of cap is on same side as numbered side of rod.

6. Install remaining seven piston and connecting rod assemblies in the same manner.

(NOTE: Recheck to see that numbered sides of connecting rods on Nos. 1, 3, 5, and 7 rods are on right side of engine and Nos. 2, 4, 6 and 8 are on left side of engine, and that rods are on proper crankpin.)

7. Install rod cap nuts and tighten to 40 foot-pounds.

8. Check connecting rod end play on crankpin by tapping the two rods apart at crankpin and checking with feeler gage. An .008 inch feeler gage should always enter space between rod passes at crankpin: a .016 inch feeler gage should never enter.

9. Install oil pick-up tube and strainer assembly on cylinder block, using new O-ring. Tighten screws and nut to 18 foot-pounds.

10. Install oil pan as described in Note 127b.

11. Install cylinder heads as described in Note 124b.

12. If working on Eldorado, install engine in vehicle chassis as described in Note 113b.

137. Connecting Rod Bearing Clearance Checking and Replacement

Worn bearings can be replaced without removing the rod and piston assembly by removing the cap and replacing the upper and lower halves. The clearance between the connecting rod bearing and the crankshaft can be measured by the of plastic gauging material, as follows:

1. Remove bearing cap and wipe oil from crankshaft journal and bearing insert.

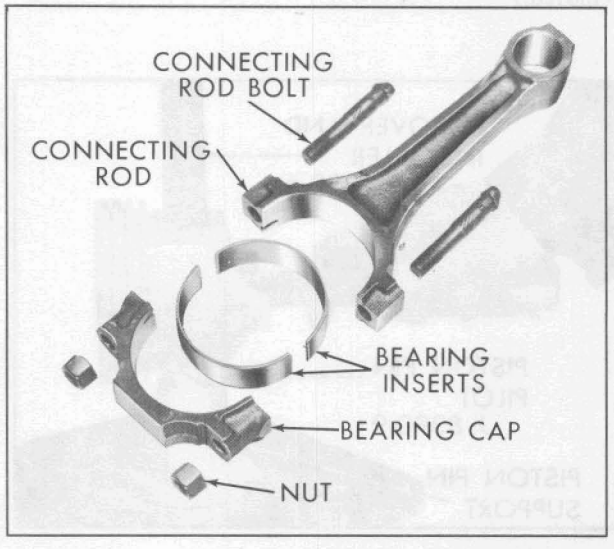


Fig. 6-151 Connecting Rod and Bearing

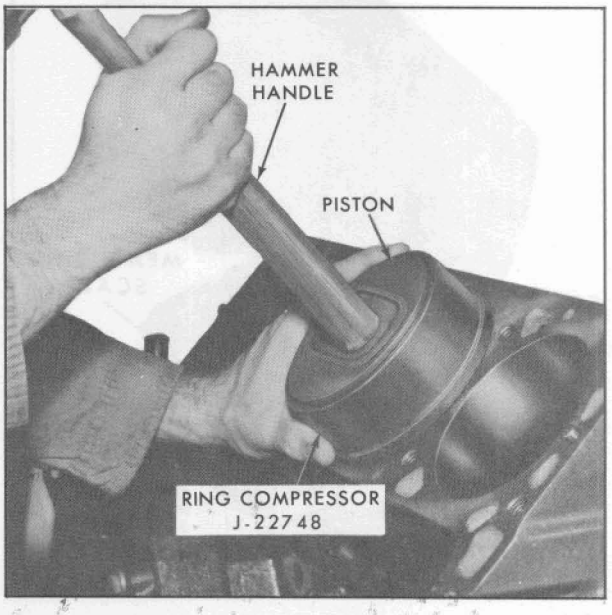


Fig. 6-152 Installing Piston In Cylinder Block

2. With crankpin at approximate bottom dead center, place a piece of plastic gauging material in center of cap.

(NOTE: When using plastic gauging material, plastic material and part being measured must both be at room temperature. If parts are excessively warm, an incorrect reading may result. Fresh plastic gauging material is recommended for greatest accuracy.)

3. Reinstall bearing cap. Tighten screws to 40 foot-pounds.

(NOTE: It is extremely important to position tangs on bearings in notches in rod and cap.)

4. Remove bearing cap and determine clearance by comparing width of flattened plastic gauging material, at its widest point, with graduations on plastic gauging material container. Number within matching graduation on envelope indicates clearance in thousandths of an inch, Fig. 6-153.

If clearance is greater than .0035 inch, replace bearing. If new bearings do not reduce clearance to less than .0035 inch, crankshaft must be replaced to obtain specified limits. If both new bearings and new crankshaft are installed, clearance should be from .0005 inch to .0028 inch.

138. Piston Ring Replacement

Each piston has two compression rings and a side-seal type oil ring that incorporates a steel expander and two identical chrome plated steel rails. The top compression ring is molybdenum filled cast iron. The second compression ring is coated cast iron.

When replacing piston rings, install only re-ring sets that have molybdenum filler upper compression ring, and multi-piece oil rings.

The compression rings are chamfered on the lower inner face. There is a locating "dimple" on both rings near the end for easy identification on the top side. Install with top side, "dimple", facing up.

1. Place ring in area of cylinder where piston ring will travel. Be sure ring is square with cylinder bore by positioning ring with piston head.
2. Gap between compression ring ends should be .013 inch to .025 inch.
3. Gap between oil ring ends should be .015 inch to .055 inch.
4. With compression ring on piston, clearance between top surface of piston ring and ring land should be no greater than .005 inch. If clearance is greater, replace the ring. If the new ring does not reduce the clearance to .005 inch or less, new pistons should also be installed.

Clearance on new rings and new pistons should be .0017 inch to .0040 inch. This can be checked with a .0015 inch and .005 inch feeler gage on a "go-no-go" basis. The .0015 inch feeler gage should always enter; the .005 inch feeler gage should never enter. When installing rings on piston, gaps in piston rings should be staggered by approximately 120°.

139. Piston Pin

a. Removal

1. Place Piston Pin Support, J-8390-8, on arbor press.
2. Insert Piston Pin Pilot, J-8390-9, in piston pin on side opposite letter "R" on piston.
3. Position piston and connecting rod assmebly on support with side of piston marked with the letter "R" upward, Fig. 6-154.
4. Insert pilot end of Piston Pin Remover and Installer, J-8390-6, into piston pin and press pin out of piston and rod assembly.
5. Remove assembly from press and remove piston from support.

(NOTE: Keep piston pins in order so that they can be installed in the piston from which they were removed.)

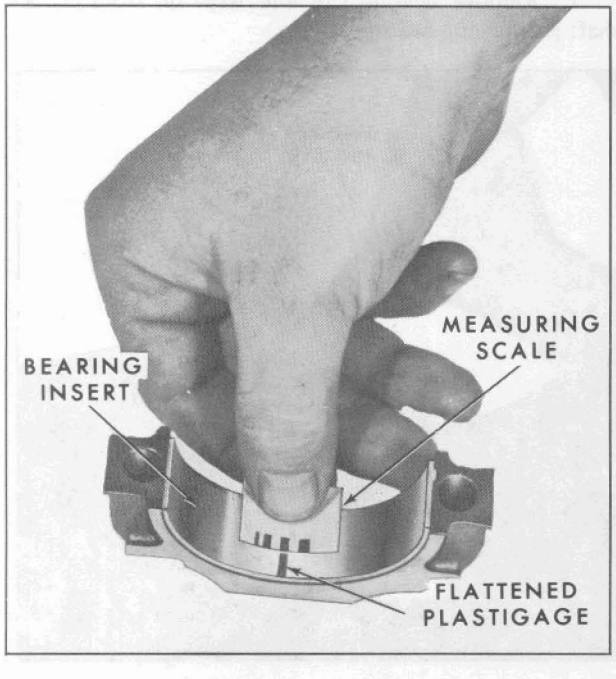


Fig. 6-153 Checking Bearing Clearance

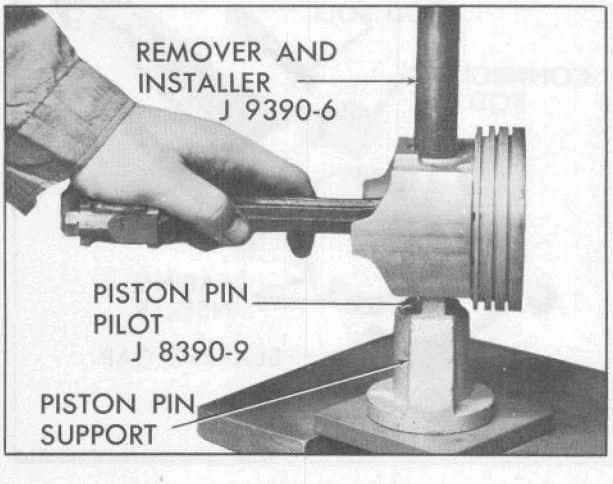


Fig. 6-154 Piston Pin Removal

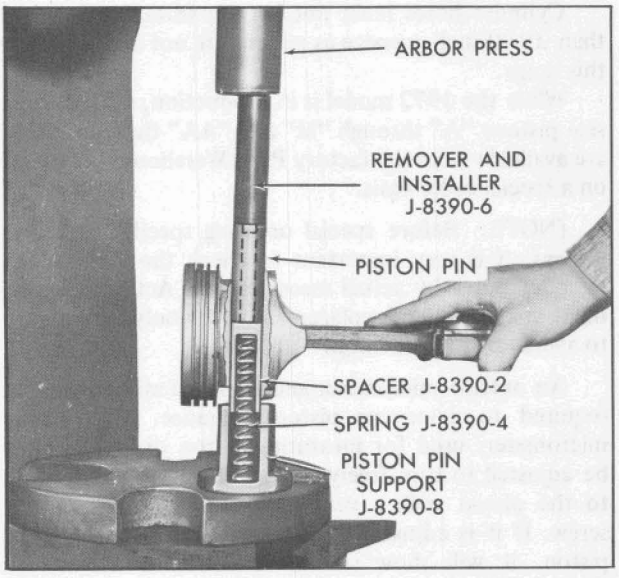


Fig. 6-155 Piston Pin Installation

b. Installation

1. Lubricate piston pin and pin holes in piston with engine oil to facilitate installation.

2. Place Piston Pin Support, J-8390-8, on arbor press with Spring, J-8390-4, and Spacer, J-8390-2, with open end over spring in position in Support, Fig. 6-155.

3. Position connecting rod in its respective piston so that, when assembly is installed in engine, side of piston stamped with the letter "R" is toward rear of the engine and number on lower end of rod is down (Numbers 1, 3, 5, and 7 are in the right bank and 2, 4, 6, and 8 are in the left bank).

4. Position piston with connecting rod on Piston Pin Support, and insert piston pin into position as shown in Fig. 6-155.

5. Place Piston Pin Remover and Installer, J-8390-6, on piston pin and press pin until it bottoms on spacer in support. Remove piston and connecting rod from support. Center pin in piston, this will properly locate the connecting rod on the piston pin and piston.

(NOTE: Piston pins are a selective fit to the piston and are not available separately. Piston pins will not normally wear enough to cause a knock or tapping; however in cases where wear is abnormal, a new piston and pin assembly should be installed.)

140. Piston Identification

Engines are available with two different displacements. The Eldorado uses a 500 cubic inch engine, while all other cars utilize a 472 cubic inch engine. Since both engines are of the same design and have an identical 4.30" bore size, it is important to install the correct piston for the engine being worked on. Pistons for both engines are shown in Fig. 6-156.

(NOTE: Dimensions shown in Fig. 6-156 are for reference purposes only and therefore not exact.)

141. Piston Clearance

When measuring piston diameter, the micrometer

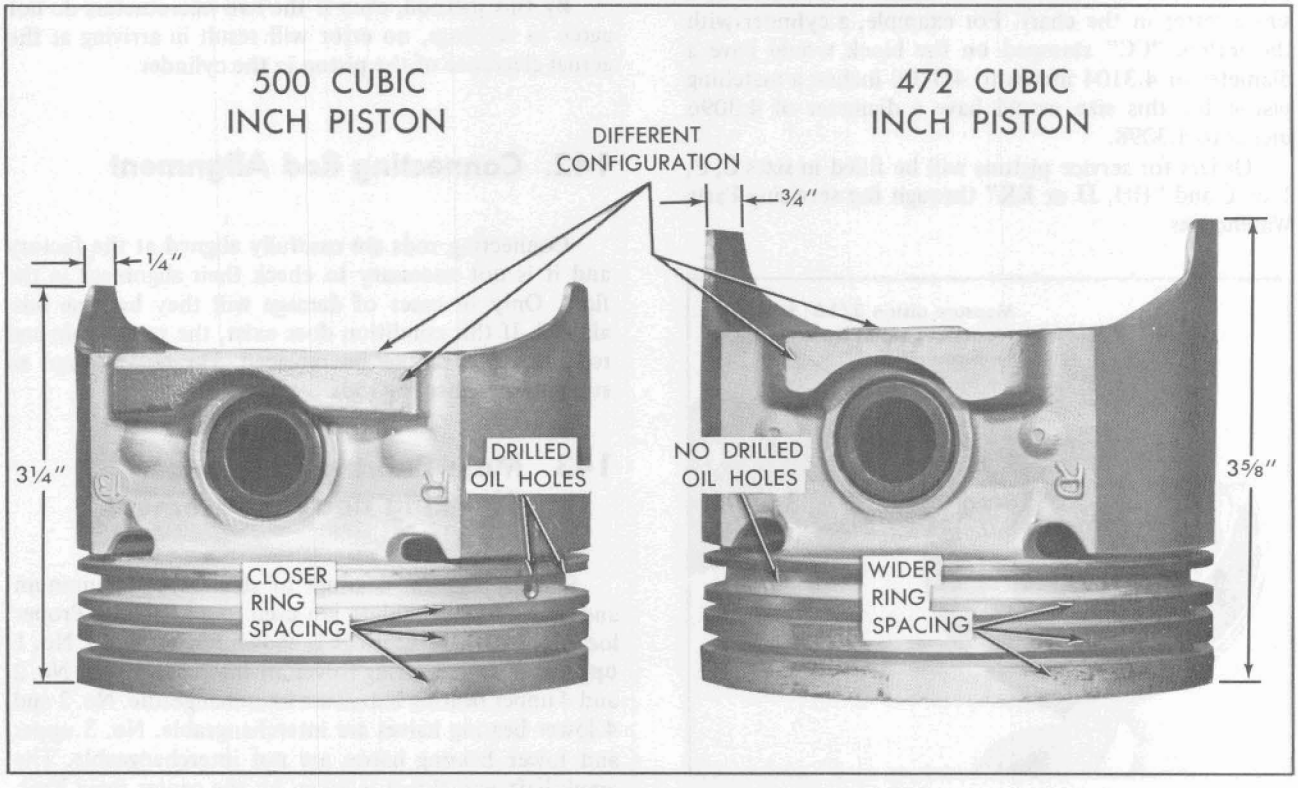


Fig. 6-156 Piston Identification

should be placed 3/16 inch below the cross slot or 1/4 inch below the oil ring groove, Fig. 6-157. Cylinders must be measured by placing the micrometer 1-1/8 inches from the top, and perpendicular to the centerline of the face.

An identification letter is stamped on the cylinder head face of the cylinder block. The letter is located directly below the cylinder bore. This letter denotes the cylinder-piston size as shown in the following table:

Letter	Cylinder Size (Diameter in Inches)	Piston Size (Diameter in Inches)
A	4.3000 - 4.3002	4.2992 - 4.2994
B	4.3002 - 4.3004	4.2994 - 4.2996
C	4.3004 - 4.3006	4.2996 - 4.2998
D	4.3006 - 4.3008	4.2998 - 4.3000
E	4.3008 - 4.3010	4.3000 - 4.3002
H	4.3010 - 4.3012	4.3002 - 4.3004
J	4.3012 - 4.3014	4.3004 - 4.3006
K	4.3014 - 4.3016	4.3006 - 4.3008
L	4.3016 - 4.3018	4.3008 - 4.3010
M	4.3018 - 4.3020	4.3010 - 4.3012

The table indicates ten piston sizes ranging in steps of .0002 inch from 4.2992 inches to 4.3012 inches. This makes it possible to maintain the .0006 to .0010 inch piston to cylinder wall clearance. The sizes shown apply at 70°F.

If double letters (such as "AA", "BB") appear on the cylinder head face of the block just above the cylinder bore, it indicates that this particular cylinder has been bored to .010 inch over the diameter indicated by a single letter in the chart. For example, a cylinder with the letters "CC" stamped on the block would have a diameter of 4.3104 inches to 4.3106 inches; a matching piston for this size would have a diameter of 4.3096 inches to 4.3098.

Orders for service pistons will be filled in sizes C, E, J or L and "HH, JJ or KK" through the servicing Parts Warehouses.

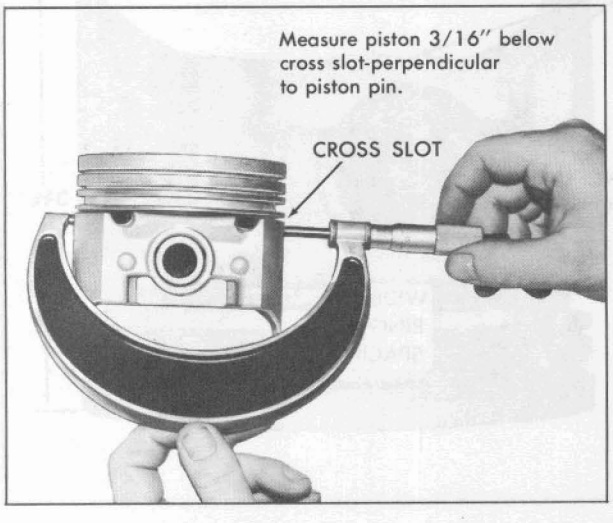


Fig. 6-157 Measuring Piston Diameter

Cylinder bores must not be reconditioned to more than .0100 inch oversize as pistons are not available over this range.

While the 1972 model is in production, specific code size pistons "A" through "M" and "AA" through "MM" are available from the factory Parts Warehouse in Detroit on a special order basis.

(NOTE: Before special ordering specific code size pistons, it is very important to check the sizes of the cylinder bores by actual measurement. Actual measurement at the time of replacement is the only certain way to avoid error in ordering.)

An outside micrometer and an inside micrometer are required to determine piston clearance. The outside micrometer, used for measuring piston diameter, must be adjusted to turn freely so that it can be adjusted up to the piston with a very light turning effort on the screw. If it is adjusted to get a frictional feel over the piston, it will show several tenths of a thousandth smaller than its actual size. With practice, frational thousandths can be checked accurately.

The inside micrometer for measuring the cylinders may be used with or without an extension handle. It should be adjusted so the screw turns sufficiently tight to retain its setting while checking the cylinder at the different points to be measured.

The direct readings shown on the inside micrometer should not be taken as the cylinder sizes. With one end of the micrometer contacting the cylinder wall and the other being oscillated, adjust the micrometer until it will just slip through the cylinder with a light drag. Remove the micrometer, obtaining the same feel as when measuring the piston.

By this method, even if the two micrometers do not agree in readings, no error will result in arriving at the actual clearance of the piston in the cylinder.

142. Connecting Rod Alignment

Connecting rods are carefully aligned at the factory and it is not necessary to check their alignment in the field. Only in cases of damage will they become misaligned. If this condition does exist, the piston, pin and rod assembly should be replaced. Do not attempt to straighten connecting rods.

143. Main Bearing Clearance Checking and Replacement

Shell type main bearings of steel-backed aluminum and steel-backed babbitt are used in all engines. Proper location for these bearings is shown in Fig. 6-158. No. 1 upper and lower bearing halves are interchangeable. No. 2 and 4 upper bearing halves are interchangeable. No. 2 and 4 lower bearing halves are interchangeable. No. 3 upper and lower bearing halves are not interchangeable. The crankshaft end thrust is taken by the center main bearing. The worn limit for crankshaft end play is .015 inch.

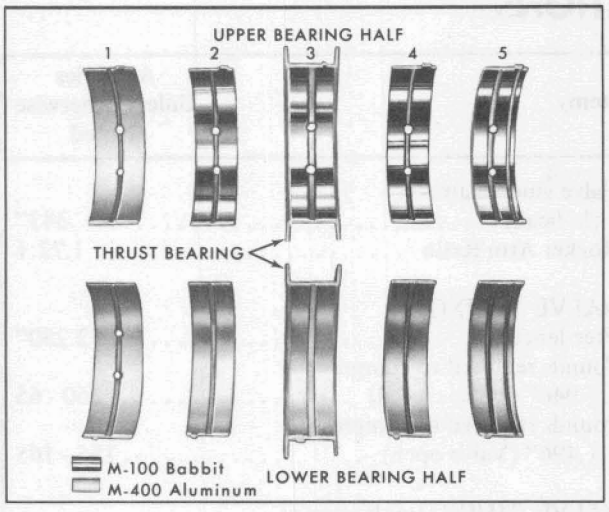


Fig. 6-158 Main Bearing Location

a. To Check a Main Bearing

1. Remove bearing cap to be checked.
2. Measure bearing wear using the plastic gauging material method as described in Note 137. Bearing cap must be tightened to 90 foot-pounds.

CAUTION: If bearings are being measured with engine in chassis, crankshaft must be supported in order to take up clearance between upper bearing shell and crankshaft. This can be done by removing bearing caps adjacent to bearing being checked, and placing a strip of .005 inch brass shim stock between lower bearing shell and crankshaft bearing journal. When reinstalling bearing caps, lightly tighten attaching screws to avoid damaging bearing caps.

3. If bearing clearance is greater than .0045 inch, replace bearing.

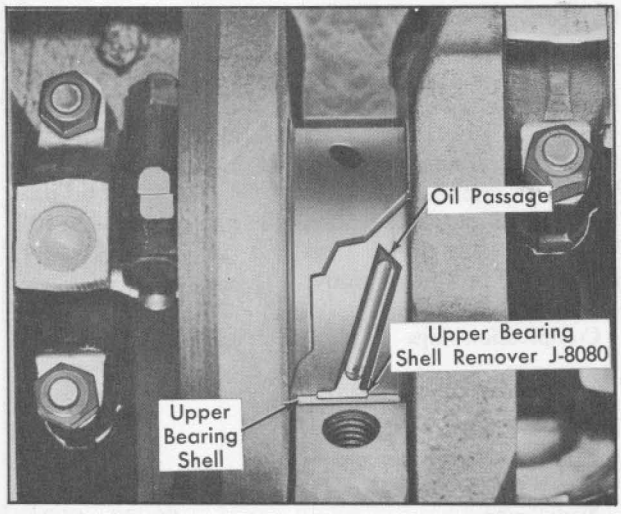


Fig. 6-159 Removing Upper Bearing Shell

4. If new bearings do not reduce the clearance to less than .0045 inch, crankshaft should be replaced.

If both new bearings and new crankshaft are installed, clearance should be .0003 inch to .0026 inch for all bearings except front bearing. Clearance for front bearing should be .0001 inch to .0024 inch.

b. Main Bearing Replacement

1. If working on Eldorado, remove engine from vehicle chassis as described in Note 113a.
2. Remove engine oil pan as described in Note 127a.
3. Remove two cap screws and nut that hold oil intake screen assembly to cylinder block and remove screen assembly. Discard O-ring.
4. Remove spark plugs.
5. Remove two screws that hold bearing cap to cylinder block and remove cap. Remove worn shell from cap and discard.

(NOTE: Each bearing cap has a number of dimples (1, 2, 3, 4) machined on the bottom starting from the front of the engine, as shown in Fig. 6-150. Do not mismatch these caps or turn them around because they are individually matched when the cylinder block is machined.)

6. Install Upper Bearing Shell Remover, J-8080, into oil hole in crankshaft bearing journal, Fig. 6-159.
7. Slowly rotate crankshaft clockwise (viewed from front of engine) until tool contacts and forces out upper shell.
8. Install new upper shell in place as far as possible by hand, with locating tang in correct position. Remover Tool, J-8080, may also be used to aid in installing new upper shell. Install tool in crankshaft oil passage so that tool bears against notched end of bearing shell. Rotate crankshaft counterclockwise to position bearing, then remove tool, Fig. 6-159.
9. Install new lower shell in cap with locating tang in correct position.

(NOTE: When replacing the rear main bearing, use a new oil seal as described in Note 129.)

10. Install cap on cylinder block and secure with two attaching screws. Tighten screws to 90 foot-pounds.
11. Replace four remaining bearings in same manner.

(NOTE: When replacing center bearing it is necessary to line up bearing thrust surfaces. To do this, install bearing cap screws finger tight. Then, using a plastic hammer, tap crankshaft fore and aft the limit of its travel several times. Do not use hammer on connecting rods, tap on counterweights only.)

12. Install spark plugs and tighten to 25 foot-pounds. Connect spark plug wires at plugs.
13. Install oil intake screen assembly on cylinder block using new O-ring, and secure with attaching screws and nut. Tighten to 18 foot-pounds.
14. Install oil pan as described in Note 127b.
15. If working on Eldorado, install engine in vehicle chassis as described in Note 113b.

SPECIFICATIONS

Items	All Series Unless Otherwise Noted
ALL EXCEPT ELDORADO 500	
Bore	4.300"
Stroke	4.060"
Piston Displacement	472 cu. in.
Compression Ratio	8.5 to 1
Compression Pressure -	
At cranking speed (throttle open)	165-185 psi
At 1000 rpm	212-230 psi
Points of Suspension	3
ELDORADO 500	
Bore	4.300"
Stroke	4.304"
Piston Displacement	500 cu. in.
Compression Ratio	8.5 to 1
Compression Pressure -	
At cranking speed (throttle open)	165-185 psi
At 1000 rpm	212-230 psi
Points of Suspension	3
VALVES, EXHAUST	
Clearance between stem and guides --	
New limits	.0012" - .0027"
Worn limits, not over	.005"
Clearance between lifter body and crankcase	.0005" - .0020"
Head diameter, overall	1.625"
Lift	.490"
Valve Face Angle	44°
Valve Seat Angle (in head)	45°
Seat width in head	1/16"
Seat eccentricity, not over (total indicator reading)	.004"
Stem diameter	.3413" - .3418"
Valve guide diameter (in head)	.343"
Rocker Arm Ratio	1.72:1
VALVES, INLET	
Clearance between stem and guide --	
New limits (in head)	.001" - .0027"
Worn limits, not over	.005"
Clearance between lifter body and crankcase	.0005" - .0020"
Head diameter, overall	2.000"
Lift	.490"
Valve Face Angle	44°
Valve Seat Angle (in head)	45°
Seat Width in head	1/16"
Seat eccentricity, not over (total indicator reading)	.004"
Stem diameter	.3413" - .3420"
Valve guide diameter (in head)	.343"
Rocker Arm Ratio	1.72:1
VALVE SPRINGS	
Free length	2.250"
Pounds required to compress to 1.946" (Valve closed)	60 - 65
Pounds required to compress to 1.496" (Valve open)	155 - 165
VALVE TIMING (with ramp at .001" lift)	
Intake opens	34° B.T.D.C.
Intake closes	100° A.B.D.C.
Exhaust opens	78° B.B.D.C.
Exhaust closes	56° A.T.D.C.
CONNECTING RODS	
Bearing Material	Aluminum
Clearance between bearing and shaft --	
New limits	.0005" - .0028"
Worn limits, not over	.0035"
Diameter lower end, without bearing	2.643 - 2.650
Length, center to center	6.75"
End play of rods on crank pin	.008" - .016"
PISTON RINGS	
Clearance between rings and sides of groove in piston --	
Compression rings	.0017" - .0040"
Oil rings	.NONE - Side Sealing
Gap between ends	
Compression rings	.013" - .025"
Oil rings	.015" - .055"
Number of compression rings	2
Number of oil rings	1
Width of compression ring groove	.0802" - .0810"
Width of oil ring groove	.188" - .189"
Diameter at bottom of groove	
Oil ring	3.880" - 3.874"
Compression rings	3.843" - 3.849"
PISTON PINS	
Clearance between pin and piston --	
New limits	.0002" - .0004"
Pin length	3.030"
Pin diameter	.9994" - .9999"

SPECIFICATIONS (Cont'd.)

Items	All Series Unless Otherwise Noted
PISTONS AND CYLINDERS	
Cylinder bore out-of-round (new or reground limit)	
Not over	.0005"
Piston Taper, not over	.0005" - .002"
Piston Material	Aluminum Alloy
Piston skirt top clearance	.0006" - .0010"
Piston skirt bottom clearance	-.0014" - +.0005"
Cylinder and piston sizes (as indicated by letters stamped on the cylinder head gasket surface). The letters are in groups of two for adjacent cylinders (such as "H" and "B") midway between the two cylinders. The letters denote the cylinder piston sizes as shown below).	

Letter	Cylinder Size (Diameter in Inches)	Piston Size (Diameter in Inches)
A	4.3000 - 4.3002	4.2992 - 4.2994
B	4.3002 - 4.3004	4.2994 - 4.2996
C	4.3004 - 4.3006	4.2996 - 4.2998
D	4.3006 - 4.3008	4.2998 - 4.3000
E	4.3008 - 4.3010	4.3000 - 4.3002
H	4.3010 - 4.3012	4.3002 - 4.3004
J	4.3012 - 4.3014	4.3004 - 4.3006
K	4.3014 - 4.3016	4.3006 - 4.3008
L	4.3016 - 4.3018	4.3008 - 4.3010
M	4.3018 - 4.3020	4.3010 - 4.3012
†AA	4.3100 - 4.3102	4.3092 - 4.3094
†BB	4.3102 - 4.3104	4.3094 - 4.3096
†CC	4.3104 - 4.3106	4.3096 - 4.3098
†DD	4.3106 - 4.3108	4.3098 - 4.3100
†EE	4.3108 - 4.3110	4.3100 - 4.3102
†HH	4.3110 - 4.3112	4.3102 - 4.3104
†JJ	4.3112 - 4.3114	4.3104 - 4.3106
†KK	4.3114 - 4.3116	4.3106 - 4.3108
†LL	4.3116 - 4.3118	4.3108 - 4.3110
†MM	4.3118 - 4.3120	4.3110 - 4.3112

OIL PUMP	
Oil pump type	Spur Gear
Backlash between drive gears	.008" - .012"
Clearance between pump body and gears --	
New limits	.003" - .005"
Worn limits, not over	.005"
No. of teeth on each gear	9

Items	All Series Unless Otherwise Noted
CRANKSHAFT AND MAIN BEARINGS	
Clearance, main bearings --	
New limits	.0003" - .0026"
Worn limits, not over	.0045"
Main bearing caps --	
Screw thread diameter	1/2"
Main bearing journal, diameter	3.250"
Main bearing journals, out-of-round not over	.00025"
Main bearing journal length --	
No. 1 and No. 5	1.1925"
No. 2 and No. 4	1.0595"
No. 3	1.0670"
Main bearings material	M-400 Aluminum and M-100 Babbitt
Crankpin diameter	2.500"
Crankpin out-of-round not over	.00025"
End play in crankshaft --	
New limits	.002" - .012"
Worn limits	.015"
OIL PRESSURE REGULATOR	
Clearance between valve plunger and housing --	
New limits	.0020" - .0035"
Worn limits, not over	.005"
Normal pressure at 30 mph	
Minimum	35 psi
Idle (average)	10 psi
Spring	
Free length	2.57" - 2.69"
Lbs. required to compress to 1-7/16"	7-1/2 - 8-1/2
Valve opens at	35 - 40 psi
CAMSHAFT	
Chain --	
Type	Silent Chain
Adjustment	None
Length	24"
Number of links	48
Pitch	.500"
Width	.750"
Bearing Clearance --	
New limits	.001" - .0022"
Worn limits, not over	.004"
Bearing out-of-round, not over	.002"
Number of bearings	5
Valve lift (intake)	.490"
Valve lift (exhaust)	.490"

†Except Eldorado

TORQUE SPECIFICATIONS

Material No.	Application	Thread Size	Torque
280-M	Camshaft Sprocket to Camshaft Screws	5/16-18	18 ft. lbs.
1010	Carburetor to Intake Manifold Screw (Front)	5/16-18	10 ft. lbs.
280-M	Carburetor to Intake Manifold Screw (Rear)	5/16-18	14 ft. lbs.
1038	Connecting Rod Nut	3/8-24	40 ft. lbs.
300-M	Cylinder Head to Cylinder Block Screw (All-Special) Oiled	1/2-13	115 ft. lbs.
Special	Cylinder Head Temperature Switch	3/8-24	6 ft. lbs.
286-M	Distributor Clamp Nut	5/16-24	15 ft. lbs.
286-M	Engine Front Support Mount to Cylinder Block Nut	3/8-24	21 ft. lbs.
286-M	Engine Front Support Mount Stud to Frame Nut	1/2-20	52 ft. lbs.
300-M	Engine Rear Support Mount to Rear Support Cross Member Bolt	3/8-16	45 ft. lbs.
280-M	Engine Rear Support Cross Member to Frame Bolt	5/16-18	20 ft. lbs.
280-M	Engine Rear Support Mount to Transmission Extension Housing Bolt	7/16-24	50 ft. lbs.
286-M	693 Engine Front Mounting Support Bracket to Crankcase Nut	3/8-24	21 ft. lbs.
286-M	693 Engine Front Support Cushion to Frame Nut	7/16-14	35 ft. lbs.
300-M	693 Engine Front Support Cushion to Engine Mounting Bracket Nut	7/16-20	57 ft. lbs.
280-M	693 Engine Rear Support Bracket to Transmission Bolt	7/16-14	50 ft. lbs.
280-M	693 Engine Rear Support Assembly to Bracket	7/16-14	46 ft. lbs.
280-M	693 Engine Rear Support Assembly to Frame (Bolt or Nut)	1/2-13	52 ft. lbs.
280-M	Exhaust Manifold to Cylinder Head Screw	3/8-16	35 ft. lbs.
260-M	Fan Blade Assembly Mounting Screw	15/16-24	18 ft. lbs.
300-M	Flex Plate to Converter Housing Screw	3/8-16	30 ft. lbs.
280-M	Flex Plate to Crankshaft Screw (All)	7/16-20	75 ft. lbs.
280-M	*Front Cover to Cylinder Block Screw	5/16-18	10 ft. lbs.
280-M	*Front Cover to Cylinder Block Screw	3/8-16	22 ft. lbs.
260-M	Fuel Pump to Engine Screw	5/16-18	12 ft. lbs.
286-M	Fuel Pump to Engine Nut	5/16-14	12 ft. lbs.
280-M	Fuel Pump Eccentric	3/8-16	35 ft. lbs.
260-M	Generator Adjusting Link to Generator Screw	5/16-18	10 ft. lbs.
260-M	Generator Support Bracket Screw	3/8-16	17 ft. lbs.
1112	Generator Support Bracket Nut	3/8-24	17 ft. lbs.
1010	Heater Hose Clamps	10-24	14 ft. lbs.
260-M	Ignition Coil Mounting Screw	5/16-18	15 ft. lbs.
280-M	Intake Manifold to Cylinder Head Screw	3/8-16	30 ft. lbs.
300-M	Main Bearing Cap to Cylinder Block Screw	1/2-13	90 ft. lbs.
260-M	Oil Pan Drain Plug	5/8-18	40 ft. lbs.
1010	Oil Pan to Cylinder Block Nut	5/16-24	10 ft. lbs.
1010	Oil Pan to Cylinder Block Screw	5/16-18	10 ft. lbs.
280-M	Oil Pick-up and Strainer to Cylinder Block Screw	5/16-18	15 ft. lbs.
286-M	Oil Pick-up Tube and Strainer Assembly to Main Bearing Bolt	3/8-24	35 ft. lbs.
Special	Oil Pressure Switch	1/4" Pipe	20 ft. lbs.
280-M	Oil Pump Assembly to Engine Screw	5/16-18	15 ft. lbs.
280-M	Pulley to Harmonic Balancer Screw	5/16-18	17 ft. lbs.
1010-M	**Rocker Arm Cover to Cylinder Head Screw/Washer	1/4-20	30 in. lbs.
300-M	Rocker Arm Support Bolt	7/16-14	60 ft. lbs.
Special	Starter Motor Brace Mounting Screw	5/16-18	12 ft. lbs.
Special	Starter Motor Brace Mounting Nut	1/4-20	70 in. lbs.
280-M	Starter Motor Mounting Screws	3/8-16	46 ft. lbs.
Special	Spark Plug	14mm	25 ft. lbs.

TORQUE SPECIFICATIONS (Cont'd.)

Material No.	Application	Thread Size	Torque
Special	Temperature Indicator Switch	1/2" Pipe	40 ft. lbs.
260-M	Thermostat Housing to Engine Screw	5/16-18	10 ft. lbs.
280-M	Transmission Housing to Cylinder Block	3/8-16	35 ft. lbs.
260-M	*Water Pump to Front Cover Screw	1/4-20	70 in. lbs.
280-M	*Water Pump to Cylinder Block Screw	5/16-18	10 ft. lbs.
280-M	*Water Pump to Cylinder Block Screw	3/8-16	22 ft. lbs.

*Refer to Fig. 6-143 for proper location.
**Retorque rocker arm covers after engine has been run.

(NOTE: Refer to back of manual, Page 16-1, for bolt and nut markings and steel classifications.)

SPECIAL TOOLS

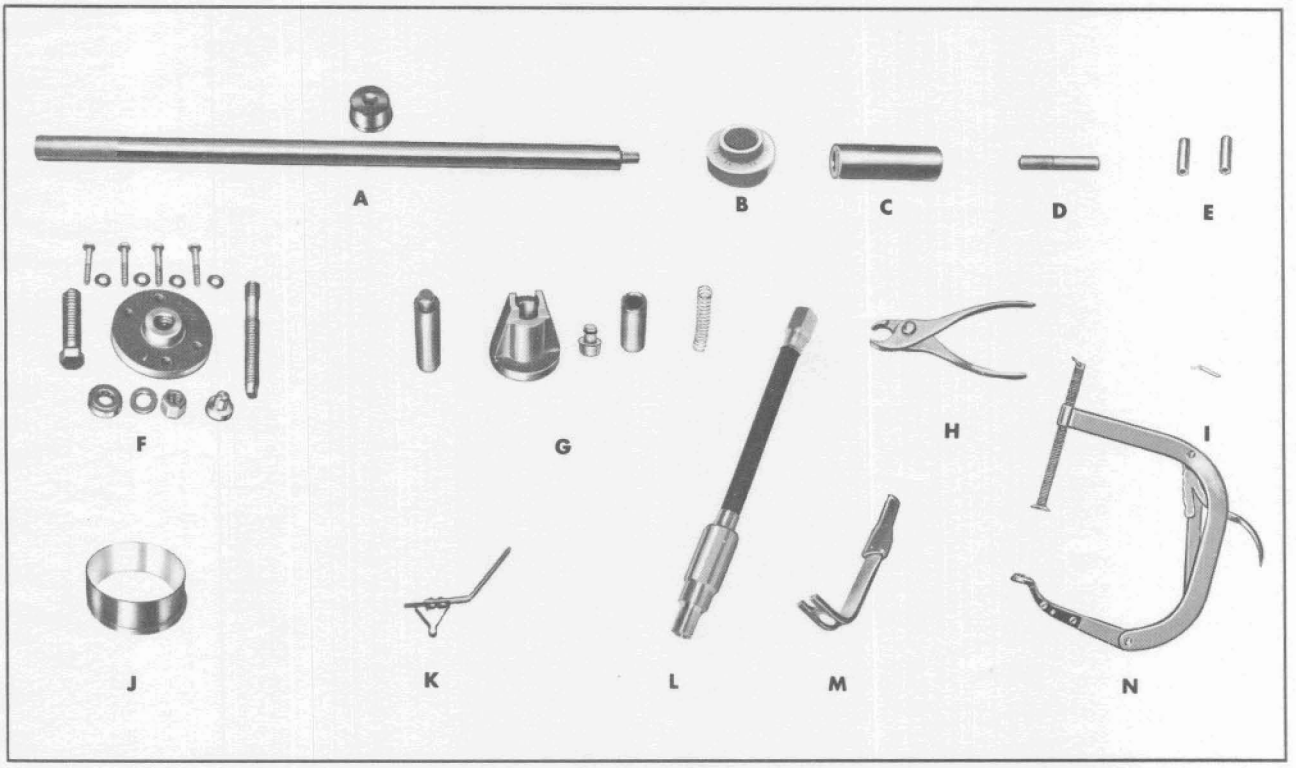


Fig. 6-160 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-21054	Camshaft Bearing Remover and Installer Set	G	J-8390-04	Piston Pin Remover and Installer Set
B	J-22770	Front Cover Oil Seal Installer	H	J-3049	Valve Lifter Remover
C	J-4160	Hydraulic Valve Lifter Plunger Remover	I	J-8080	Main Bearing Upper Shell Remover
			J	J-22748	Piston Ring Compressor
D	J-2730	Valve Lifter Lock Ring Installer	K	J-3074	Valve Lifter Leak-Down Tester
E	J-3224	Connecting Rod Bolt Guide Set	L	J-22794	Adapter
F	J-21052	Harmonic Balancer Remover and Installer Set	M	J-22765-1	Valve Spring Compressor
			N	J-22765	Valve Spring Compressor

THEORY OF OPERATION

(NOTE: For service information pertaining to the Eldorado transmission refer to the latter portion of this section, Page 7-91.

The same Turbo Hydra-matic automatic transmission, Fig. 7-1, is used on all 1972 Cadillac C-cars and is identified by the letters AA that appear in the upper corners of the name plate, Fig. 0-1.

The Turbo Hydra-matic transmission is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and a compound planetary gear set. Three multiple-disc clutches, two roller clutch units, and two bands provide the friction elements required to obtain the desired functions of the compound planetary gear set.

The torque converter, the clutches, and roller clutches, couple the engine to the planetary gears through oil pressure, providing three forward speeds and reverse. The torque converter, when required, will supplement the gears by multiplying engine torque.

The torque converter is of welded construction and is serviced as an assembly. The unit is made up of two vaned sections, or halves, that face each other in an oil filled housing. The pump half of the converter is connected to the engine and the turbine half is connected to the transmission.

When the engine makes the converter pump revolve, it sends oil against the turbine, making it revolve also. The oil then returns in a circular flow back to the converter pump, continuing this flow as long as the engine is running.

The converter also has a smaller vaned section, called a stator, that funnels the oil back to the converter pump through smaller openings, at increased speed. The speeded up oil directs additional force to the engine-driven converter pump, thereby multiplying engine torque.

A hydraulic system pressurized by an internal-external type gear pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

Manual Linkage - To select the desired operating range.

Engine Vacuum - To operate a vacuum modulator unit.

12 Volt Electrical Signals - To operate an electrical detent solenoid.

Gear or torque ratios of the transmission are as follows:

First	=	2.48:1 gear ratio
Second	=	1.48:1 gear ratio
Third	=	1.0:1 gear ratio
Reverse	=	2.08:1 gear ratio

Each gear ratio can be multiplied by as much as 2, depending upon the slip speed of the converter pump and turbine.

A vacuum modulator is used to sense engine torque input to the transmission automatically. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and proper shift spacing is obtained at all throttle openings.

The detent solenoid is activated by a switch at the carburetor. When the throttle is opened sufficiently to close this switch, the solenoid in the transmission is activated, causing a downshift at speeds below approximately 70 miles per hour. At lower speeds, downshifts will occur at lesser throttle openings without use of the switch.

The oil cooler is located in the right hand tank of the radiator, Fig. 7-2. The transmission is cooled by directing oil from the converter to the radiator. Oil returning from the radiator feeds the transmission lubrication system.

The oil system incorporates an intake pipe and filter assembly. The filter assembly should be replaced after the first 24,000 miles or two years, whichever occurs first. It should be replaced after the first 12,000 miles if heavy duty operation is encountered, such as constant use in heavy metropolitan traffic, pulling trailers, etc. In addition, replace filter assembly when a major transmission failure occurs and flush the oil cooler and cooler lines. This is particularly important in the case of a converter failure.

The transmission quadrant has six selector positions, Fig. 7-3, that enable the driver to control the operation of the transmission under various driving conditions. The six selector positions appear on the quadrant in the following sequence, from left to right; P-park, R-reverse, N-neutral, DRIVE left, DRIVE right (intermediate) and L-lo.

P - Park position positively locks the output shaft to the transmission case by means of a locking pawl and prevents the vehicle from rolling either forward or backward. For this reason, it is recommended that the engine be started with transmission selector lever in Park position. If it is necessary to re-start the engine with the car rolling, place selector lever in Neutral.

R - Reverse enables the vehicle to be operated in a reverse direction.

N - Neutral position enables the engine to be started and run without driving the vehicle. It is recommended that Neutral be used to start the engine only if it is necessary to re-start the engine with the car rolling. At all other times Park should be used.

Drive (left) - is used for all normal driving conditions and maximum economy. Drive (left) has three gear ratios from starting to direct drive. Downshifts are available for safe passing, by depressing the accelerator pedal.

Drive (right) - adds performance for congested traffic or hilly terrain. This range has the same starting ratio as Drive (left), but prevents the transmission from shifting above second speed to retain acceleration when extra performance is desired. Engine braking is provided in this range.

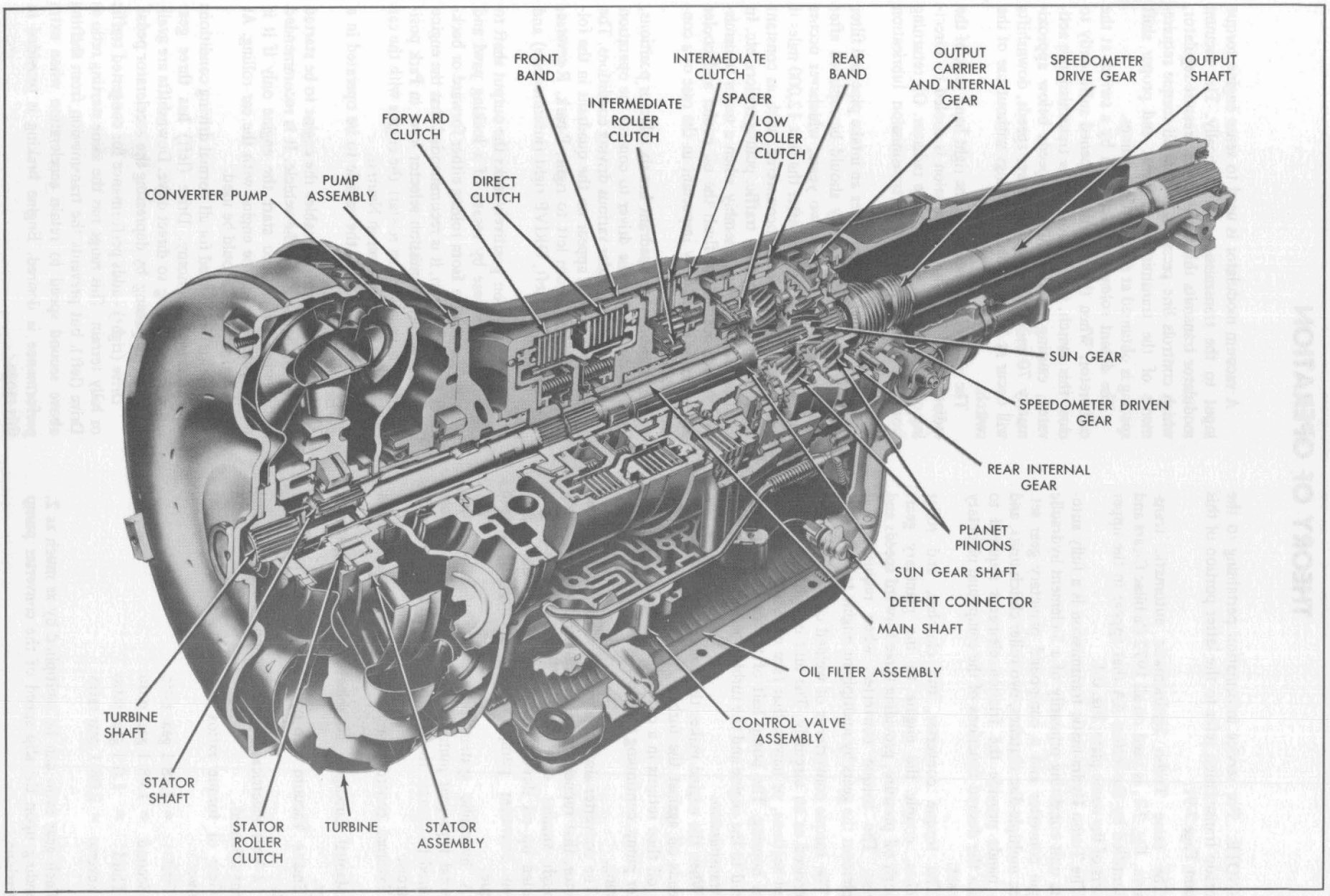


Fig. 7-1 Turbo-Hydromatic Transmission Cutaway View

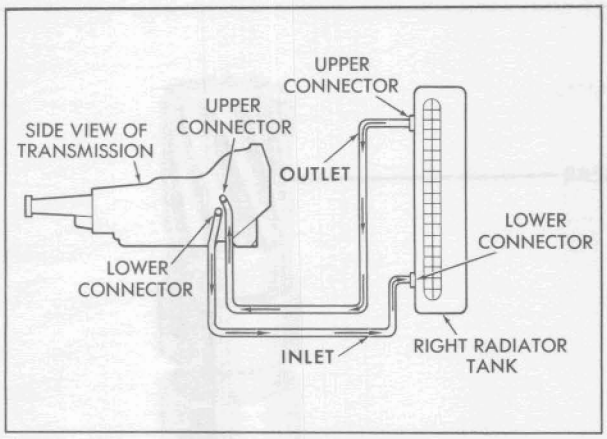


Fig. 7-2 Oil Cooler Lines

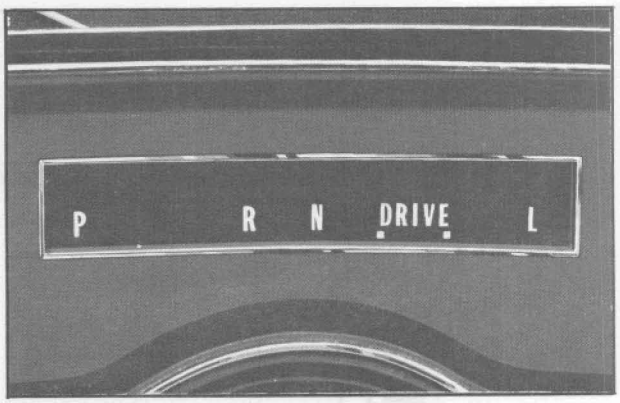


Fig. 7-3 Selector Quadrant

L - Lo range permits operation at the lowest ratio, and should be used where only the lowest gear ratio is desired, such as in pulling a heavy load or descending a steep grade. When selector lever is moved from Drive to Lo range at normal highway speeds, the transmission will shift to second gear and remain in second gear until vehicle speed is reduced to approximately 45 mph. The transmission will then shift to first gear and remain in first gear regardless of vehicle or engine speed, until selector lever is moved back into either of the Drive positions.

HYDRAULIC SYSTEM DESCRIPTION

Pressure Control

The transmission is controlled automatically by a hydraulic system, Fig. 7-4. Hydraulic pressure is supplied by the transmission oil pump, which is engine driven. Main line pressure is controlled by a pressure regulator valve train located in the pump and by the vacuum modulator which is connected to engine vacuum. The pressure regulator controls the line pressure automatically, in response to a pressure signal from a modulator valve, in such a way that the torque requirements of the transmission clutches are met and proper shift spacing is obtained at all throttle openings.

To control line pressure properly, a modulator pressure is used which varies in the same manner as torque input to the transmission. Since the torque input to the clutches is the product of engine torque and converter ratio, modulator pressure must compensate for changes in either or both of these.

To meet these requirements, modulator pressure is regulated by engine vacuum, which is an indicator of engine torque and carburetor opening. It will decrease with an increase in vehicle speed to compensate for the changing converter torque ratio, by virtue of the governor pressure influence.

Vacuum Modulator Assembly

The engine vacuum signal is received by the vacuum modulator, Fig. 7-5, which consists of an evacuated metal bellows, a diaphragm and two springs. These are so arranged that the bellows and external spring apply a force that acts on the modulator valve so that it increases modulator pressure. Engine vacuum and an internal spring oppose the bellows and spring to control modulator pressure.

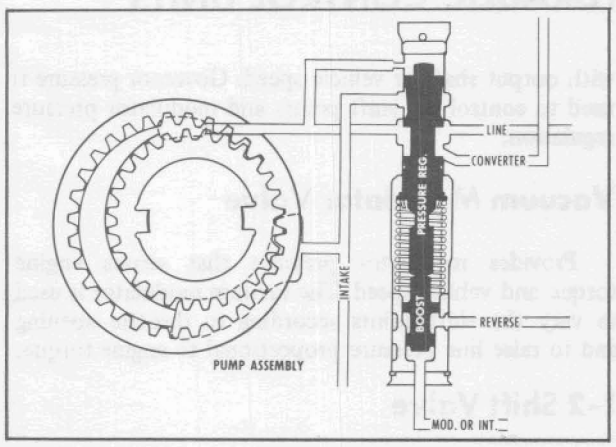


Fig. 7-4 Pressure Control

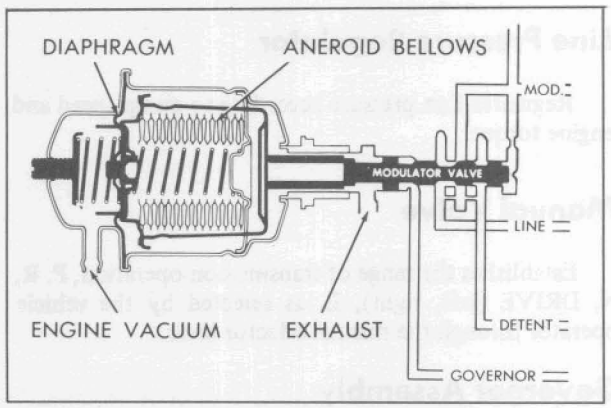


Fig. 7-5 Vacuum Modulator Assembly

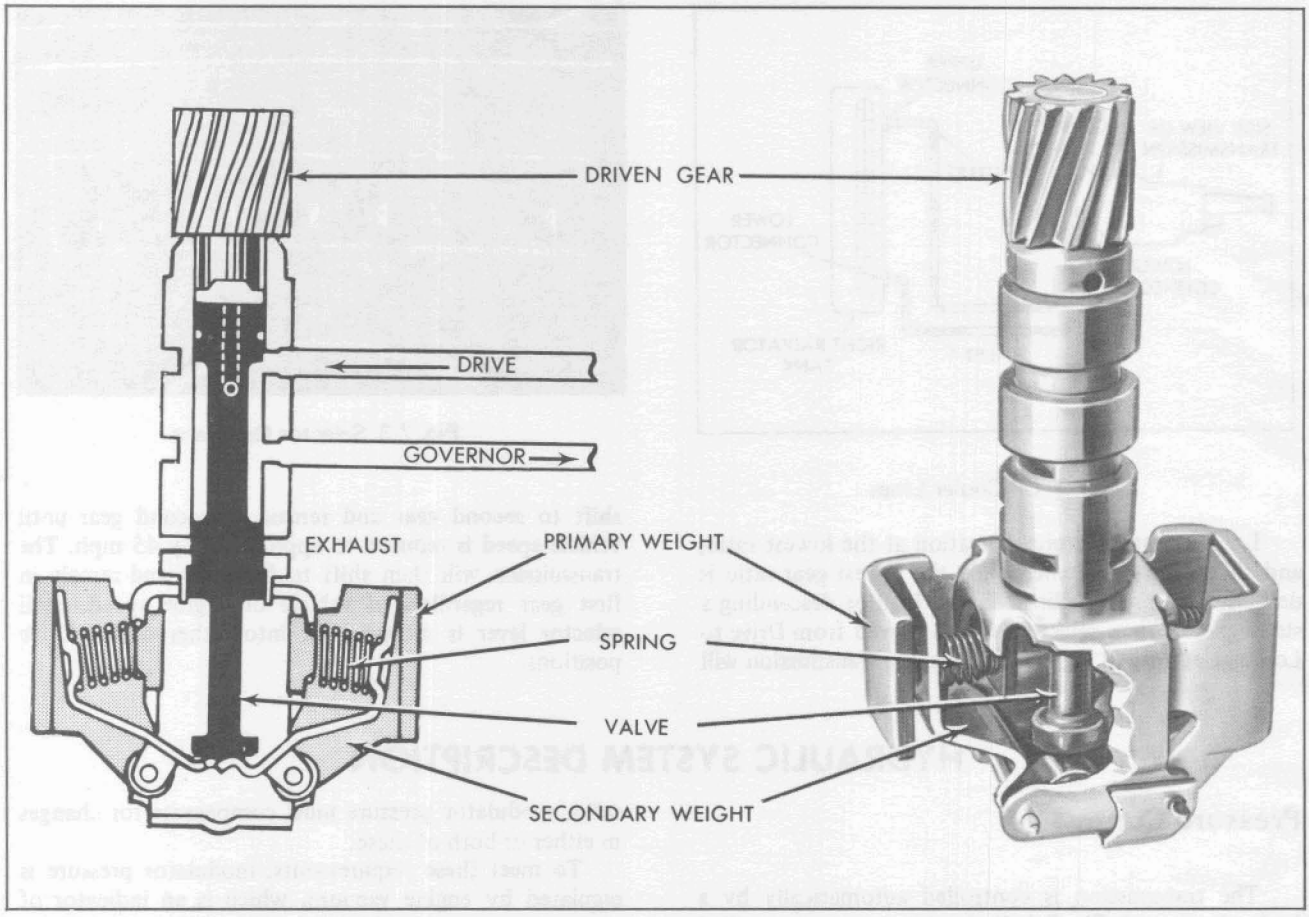


Fig. 7-6 Governor Assembly

To reduce the effect of altitude on shift points, the effective area of the diaphragm is different than that of the bellows. Atmospheric pressure acts on the resulting differential area to reduce modulator pressure.

Governor Assembly

The vehicle speed signal to the transmission is supplied by the governor, Fig. 7-6, which is driven by the output shaft. The governor consists of flyweights and a regulator valve. Centrifugal force of the flyweights is imposed on the regulator valve, causing it to regulate a pressure signal that increases with speed.

Governor pressure acts on the modulator valve to cause modulator pressure to decrease as vehicle speed increases.

FUNCTIONS OF VALVES AND HYDRAULIC CONTROL UNITS

Line Pressure Regulator

Regulates line pressure according to pump speed and engine torque.

Manual Valve

Establishes the range of transmission operation, P, R, N, DRIVE (left, right), L, as selected by the vehicle operator through the manual selector lever.

Governor Assembly

Generates a speed sensitive oil pressure that increases with output shaft or vehicle speed. Governor pressure is used to control the shift points and modulator pressure regulation.

Vacuum Modulator Valve

Provides modulator pressure that senses engine torque and vehicle speed. The vacuum modulator is used to vary the shift points according to throttle opening and to raise line pressure proportional to engine torque.

1-2 Shift Valve

Controls the speeds at which the 1-2 and 2-1 shifts occur.

1-2 Regulator Valve

Regulates modulator pressure to a proportional pressure, tending to keep 1-2 shift valve in downshift position.

1-2 Detent Valve

Senses regulated modulator pressure tending to hold 1-2 shift valve downshifted and provides an area for detent pressure for detent 2-1 shifts.

2-3 Shift Valve

Controls the speeds at which the 2-3 and 3-2 shifts occur.

2-3 Modulator Valve

Senses modulator pressure to apply a variable force that tends to hold the 2-3 shift valve downshifted.

3-2 Valve

Shuts off modulator pressure from acting on the shift valves after the direct clutch has been applied. This allows fairly heavy throttle operation in third speed without downshifting. In third speed, detent pressure or modulator pressure above 87 psi can be directed to the shift valves to provide the downshift forces.

1-2 Accumulator Valve

Regulates drive oil to a proportional lesser value that increases as modulator pressure increases, to control engagement of the intermediate clutch.

Detent Valve

Shifts when line oil is exhausted at the end of the valve when the detent solenoid is energized. This directs detent oil to the 1-2 and 2-3 modulator valves and allows the detent regulator valve to regulate.

Detent Regulator Valve

When the detent valve shifts, the detent regulator is freed to allow drive oil to enter the detent passage and thus becomes regulated at 70 psi. Detent pressures will also flow into the modulator passage which flows to the shift valves. Lo oil moves the detent regulator open to drive oil, allowing drive oil to enter the modulator and detent passages.

Rear Servo and Accumulator Assembly

The rear servo applies the rear band for engine braking in Lo range 1st gear. It applies the band in Reverse to hold the reaction carrier to provide the reverse gear ratio.

On the 1-2 shift in Drive (left and right), it serves as an accumulator for the intermediate clutch to provide a smooth shift.

Front Servo

The front servo applies the front band to provide engine braking in 2nd gear in Drive (right) and Lo ranges. It is also used as an accumulator for the apply of the direct clutch, and in conjunction with a series of check balls controlling orifices, is a part of the timing for the release of the direct clutch.

To prevent the apply of the front band in Neutral, Drive (left) and Reverse ranges, oil is directed from the manual valve to the release side of the servo piston.

In Drive (left) the servo release oil from the manual valve is used to charge the servo in preparation for the apply of the direct clutch.

Direct clutch oil is directed to the front servo accumulator piston where spring force plus direct clutch pressure stroke the piston up against the force of servo release oil. This lowers the clutch apply pressure for a smooth engagement.

The release of the direct clutch and the exhausting of the front servo accumulator is slowed down by three check balls and three orifices which permits a soft return of the drive load to the intermediate roller clutch and also allows engine rpm to increase during a detent 3-2 downshift in preparation for the lower gear ratio, which results in a smooth shift and better acceleration.

PARK OR NEUTRAL—ENGINE RUNNING POWER FLOW

Forward Clutch - Released

Roller Clutch - Ineffective

Direct Clutch - Released

Front Band - Released

Rear Band - Released

Intermediate Clutch - Released

Intermediate Roller Clutch - Ineffective

In Neutral or Park no bands or clutches are applied, therefore no power is transmitted.

OIL FLOW (Fig. 7-7)

Whenever the engine is running at idle with the selector lever in "P" or "N", oil from the pump is directed to the:

1. Pressure Regulator Valve
2. Converter
   a. Oil Cooler
   b. Cooler By-Pass Valve
   c. Lubrication System
3. Manual Valve
4. Detent Valve
5. Detent Solenoid
6. Vacuum Modulator Valve
7. Front Servo (Neutral only)

Cooling and Lubrication

Oil flows from the pump to the pressure regulator valve which regulates pump pressure. When the pump output exceeds the demand of line pressure, oil from the pressure regulator is directed to the converter feed passage to fill the converter. Oil from the converter is directed to the transmission cooler by-pass valve. Oil from the cooler is directed to the transmission lubrication system.

The cooler by-pass valve permits oil to be fed directly from the converter to lubrication circuits if the cooler becomes restricted. This by-pass is not included in service pumps.

Line pressure acts on the:

1. Manual Valve
2. Detent Valve
3. Detent Solenoid
4. Modulator Valve

Line pressure at the modulator valve is regulated to a pressure called modulator oil, which acts on the pressure boost valve, 1-2 accumulator valve and primary valves and passes through the detent valve and 3-2 valve to the 1-2 and 2-3 valve trains.

Summary

The converter is filled and all clutches and bands are released. The transmission is in Neutral.

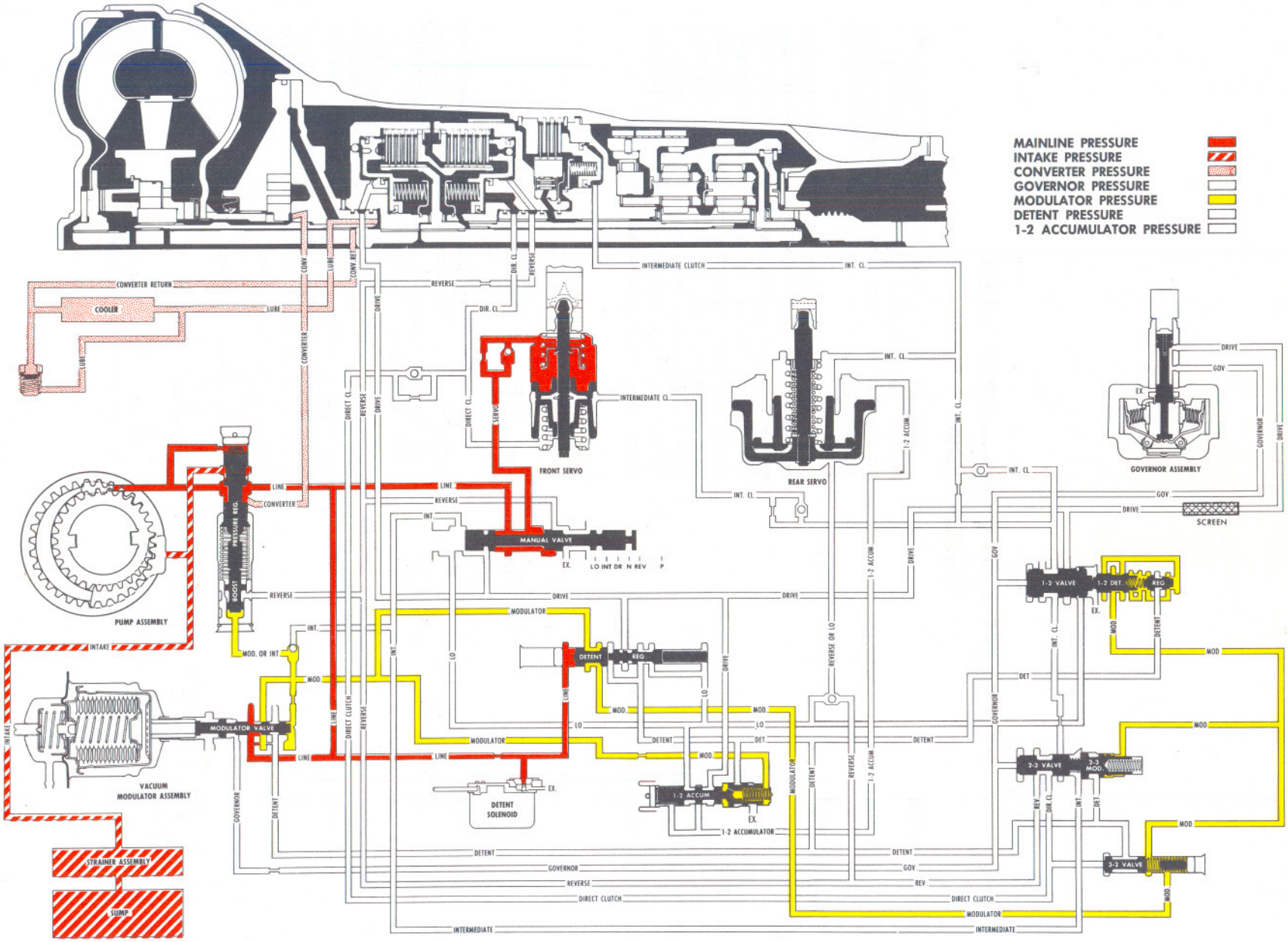


Fig. 7-7 Neutral - Engine Running

DRIVE LEFT AND RIGHT—FIRST SPEED POWER FLOW

Forward Clutch - Applied

Roller Clutch - Effective

Direct Clutch - Released

Front Band - Released

Rear Band - Released

Intermediate Clutch - Released

Intermediate Roller Clutch - Ineffective

With the selector lever in either Drive Range, the forward clutch is applied. This delivers turbine torque to the mainshaft and turns the rear internal gear in a clockwise direction. (Converter torque ratio = approximately 2:1 at stall.)

Clockwise motion of the rear internal gear causes the rear pinions to turn clockwise to drive the sun gear counterclockwise. In turn, the sun gear drives the front pinions clockwise, thus turning the front internal gear, output carrier, and output shaft clockwise in a reduction ratio of approximately 2.48:1. Reaction of the front pinions against the front internal gear is taken by reaction carrier and roller clutch assembly to the transmission case. (Approximate stall ratio - 5:1.)

OIL FLOW (Fig. 7-8)

When the selector lever is moved to either Drive position, the manual valve is repositioned to allow line pressure to enter the drive circuit. Drive oil then flows to the:

1. Forward Clutch
2. 1-2 Shift Valve
3. Governor Assembly
4. 1-2 Accumulator Valve
5. Detent Regulator Valve

Basic Control

Drive oil is directed to the forward clutch where it acts on two areas of the clutch piston to apply the forward clutch. The first, or inner area, is fed through an unrestricted passage. The outer area is fed through an orifice to insure a smooth shift into Drive.

Drive oil at the governor assembly is regulated to a variable pressure. This pressure increases with vehicle speed and acts against the ends of the 1-2 and 2-3 shift valves and an area on the modulator valve.

Drive oil is also regulated to another variable pressure at the 1-2 accumulator valve. This pressure is controlled by modulator oil and is directed to the rear servo. 1-2 accumulator oil at the rear servo acts on the accumulator piston. In addition, to maintain the lower pressure in the 1-2 accumulator passage, the 1-2 accumulator valve intermittently uncovers the lo oil passage and oil is exhausted at the manual valve.

Summary

The converter is filled. The forward clutch is applied. The transmission is in first gear.

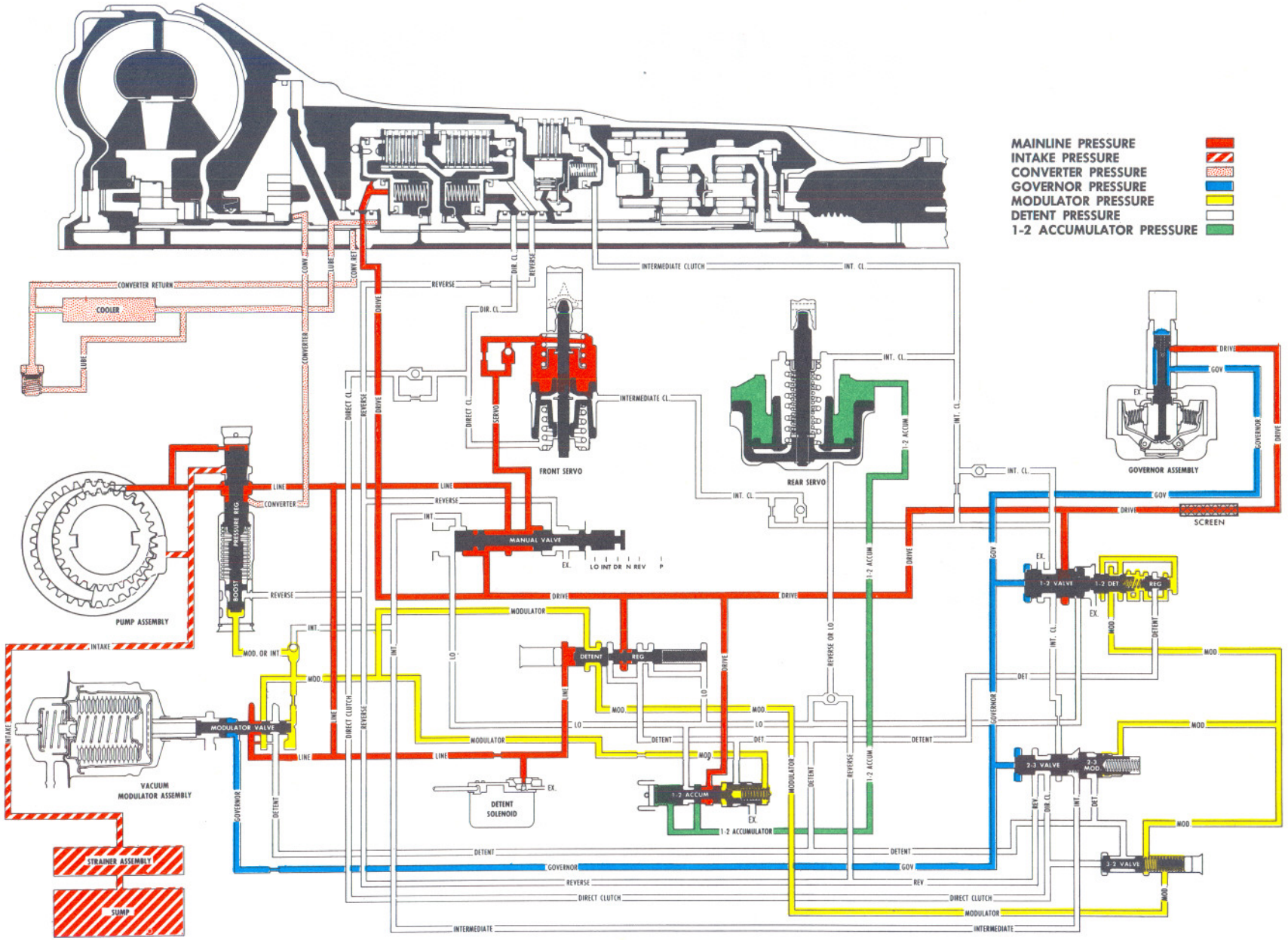


Fig. 7-8 Drive Range - First Gear

DRIVE (LEFT)—SECOND SPEED POWER FLOW

Forward Clutch - Applied

Roller Clutch - Ineffective

Direct Clutch - Released

Front Band - Released

Rear Band - Released

Intermediate Clutch - Applied

Intermediate Roller Clutch - Effective

In second, speed, the intermediate clutch is applied to allow the intermediate roller clutch to hold the sun gear against counterclockwise rotation. Turbine torque through the forward clutch is now applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.48:1.

(NOTE: Further reduction is possible, at low speeds, due to the torque multiplication provided by the converter.)

OIL FLOW (Fig. 7-9)

As both vehicle speed and governor pressure increase, the force of governor oil acting on the 1-2 shift valve will overcome the force of regulated modulator oil pressure. This allows the 1-2 shift valve to open, permitting drive oil to enter the intermediate clutch passage.

Intermediate clutch oil from the 1-2 shift valve is directed to the:

1. Intermediate Clutch
2. Rear Servo
3. Front Servo and Accumulator Pistons
4. 2-3 Shift Valve

Basic Control

Intermediate clutch oil from the 1-2 shift valve seats a one-way check ball and flows through an orifice to the intermediate clutch. At the same time, intermediate clutch oil moves the accumulator piston against the 1-2 accumulator oil and accumulator spring to maintain lower pressure in the clutch during a 1-2 shift for a smooth clutch apply. Intermediate clutch oil seats a second one-way check ball and flows to the front servo and accumulator pistons. Intermediate clutch oil is also directed to a land of the 2-3 shift valve.

Summary

The forward and intermediate clutches are applied. The transmission is in second speed.

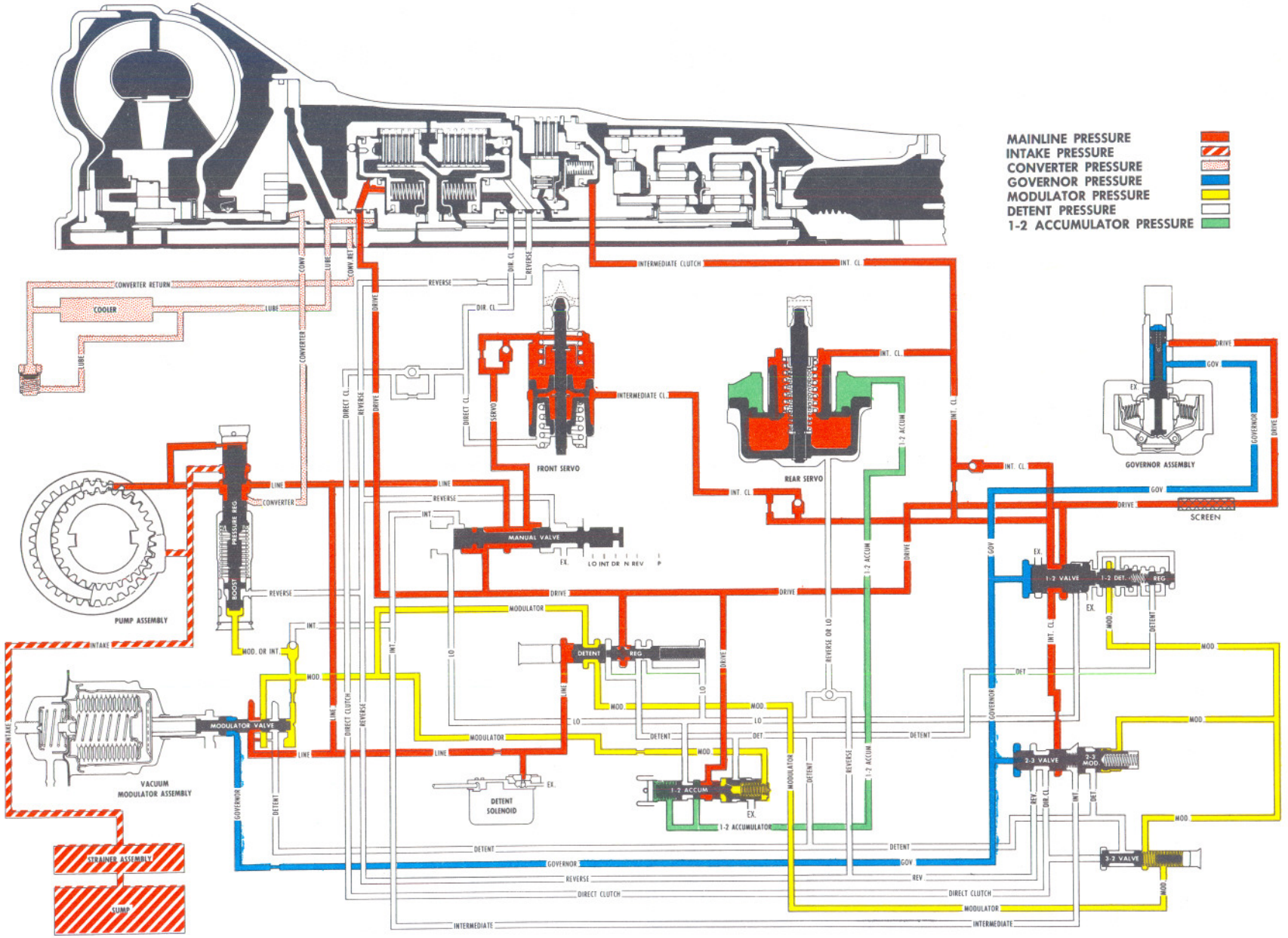


Fig. 7-9 Drive Left - Second Gear

DRIVE (LEFT)—THIRD SPEED POWER FLOW

Forward Clutch - Applied

Roller Clutch - Ineffective

Direct Clutch - Applied

Front Band - Released

Rear Band - Released

Intermediate Clutch - Applied

Intermediate Roller Clutch - Ineffective

In direct drive, engine torque is transmitted from the converter, through the forward clutch to the mainshaft and rear internal gear. Because the direct clutch is applied, equal power is also transmitted to sun gear shaft and sun gear. Since both sun gear and internal gears are now turning at the same speed, the planetary gear set is essentially locked and turns as one unit in direct drive or a ratio of 1:1.

OIL FLOW (Fig. 7-10)

As vehicle speed and governor pressure increase, force of governor oil acting on the 2-3 shift valve overcomes the force of 2-3 shift valve spring and modulator oil. This allows the 2-3 shift valve to move, feeding intermediate clutch oil to the direct clutch passage.

Direct clutch oil from the 2-3 shift valve is directed to the:

1. Direct Clutch
2. Front Accumulator Piston
3. 3-2 Valve

Basic Control

Direct clutch oil from the 2-3 shift valve flows past a one-way check valve to the inner area of the direct clutch piston to apply the direct clutch. Simultaneously, direct clutch oil is fed to the front accumulator piston. Pressure of the direct clutch oil, combined with the accumulator spring, moves the accumulator and servo pistons against servo oil. This acts as an accumulator for a smooth direct clutch apply.

Direct clutch oil is also supplied to the 3-2 valve to move the valve against modulator pressure. This cuts off modulator oil to the 1-2 regulator and 2-3 modulator valves and allows the transmission to utilize the torque multiplying characteristics of the converter during medium throttle operation without downshifting.

Summary

The forward, intermediate and direct clutches are applied. The transmission is in third gear (direct drive).

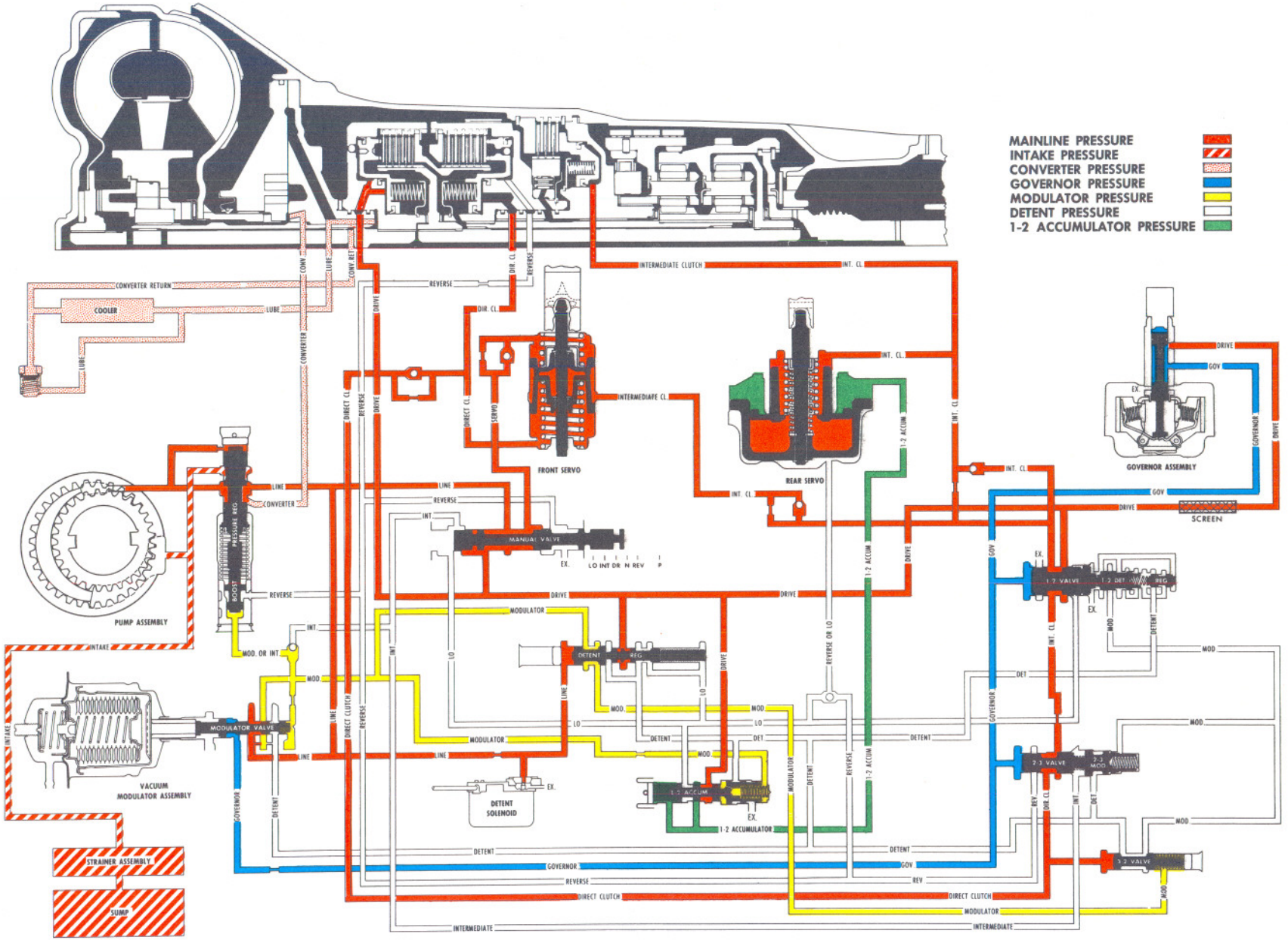


Fig. 7-10 Drive Left - Third Gear

PART THROTTLE 3-2 DOWNSHIFTS
POWER FLOW

Forward Clutch - Applied

Roller Clutch - Ineffective

Direct Clutch - Released in 2nd

Direct Clutch - Applied in 3rd

Front Band - Released

Rear Band - Released

Intermediate Clutch - Applied

Intermediate Roller Clutch - Effective in 2nd

Intermediate Roller Clutch - Ineffective in 3rd

In second speed, the intermediate clutch is applied to allow the intermediate roller clutch to hold the sun gear against counterclockwise rotation. Turbine torque through the forward clutch is now applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.48:1.

OIL FLOW (Fig. 7-11)

A part throttle 3-2 downshift can be accomplished below approximately 33 mph by depressing the accelerator far enough to raise modulator pressure to approximately 87 psi. Modulator pressure and the 3-2 valve spring will move the 3-2 valve against direct clutch oil and allow modulator oil to act on the 2-3 modulator valve. This moves the 2-3 valve train against governor oil and shifts the transmission to second speed.

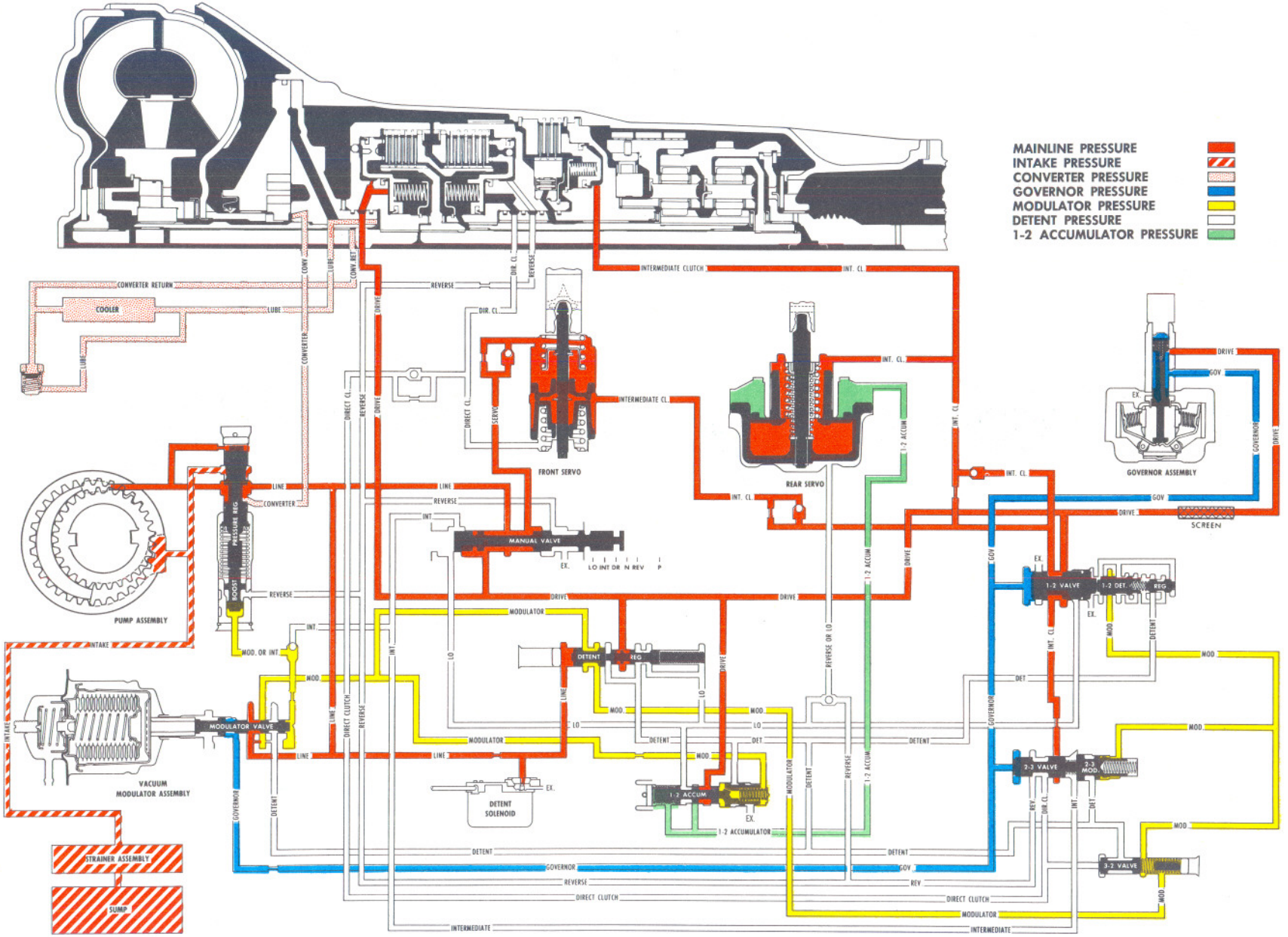


Fig. 7-11 Part Throttle 3-2 Downshift

DETENT 3-2 DOWNSHIFT POWER FLOW

Forward Clutch - Applied

Roller Clutch - Ineffective

Direct Clutch - Released in 2nd

Direct Clutch - Applied in 3rd

Front Band - Released

Rear Band - Released

Intermediate Clutch - Applied

Intermediate Roller Clutch - Effective in 2nd

Intermediate Roller Clutch - Ineffective in 3rd

In second speed, the intermediate clutch is applied to allow the intermediate roller clutch to hold the sun gear against counterclockwise rotation. Turbine torque through the forward clutch is now applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.48:1.

OIL FLOW (Fig. 7-12)

While operating at speeds below approximately 70 mph a forced or detent 3-2 downshift is possible by depressing the accelerator to 60° throttle opening. This energizes the switch at the carburetor and actuates the detent solenoid. The detent solenoid opens an orifice that allows line oil at the detent valve to be exhausted, thus permitting the detent regulator valve to operate. Line oil acting on the detent valve and solenoid is supplied by a small orifice.

Drive oil on the detent regulator valve is then regulated to a pressure of approximately 70 psi and called detent oil. Detent oil is then routed to the:

1. Modulator Passage
2. 1-2 Regulator Valve
3. 2-3 Modulator Valve
4. 3-2 Valve
5. 1-2 Primary Accumulator Valve
6. Vacuum Modulator Valve

Detent oil in the modulator passage and at the 2-3 modulator valve will close the 2-3 shift valve, shifting the transmission to second gear.

Detent 2-1 Downshift

A detent 2-1 downshift can also be accomplished below approximately 25 mph because detent oil is directed to the 1-2 regulator valve. This allows detent oil to act on the 1-2 regulator, and 1-2 detent valve to close the 1-2 shift valve, shifting the transmission to first gear.

Detent oil is directed to the modulator valve to prevent modulator pressure from regulating below 70 psi at high speeds or at high altitudes.

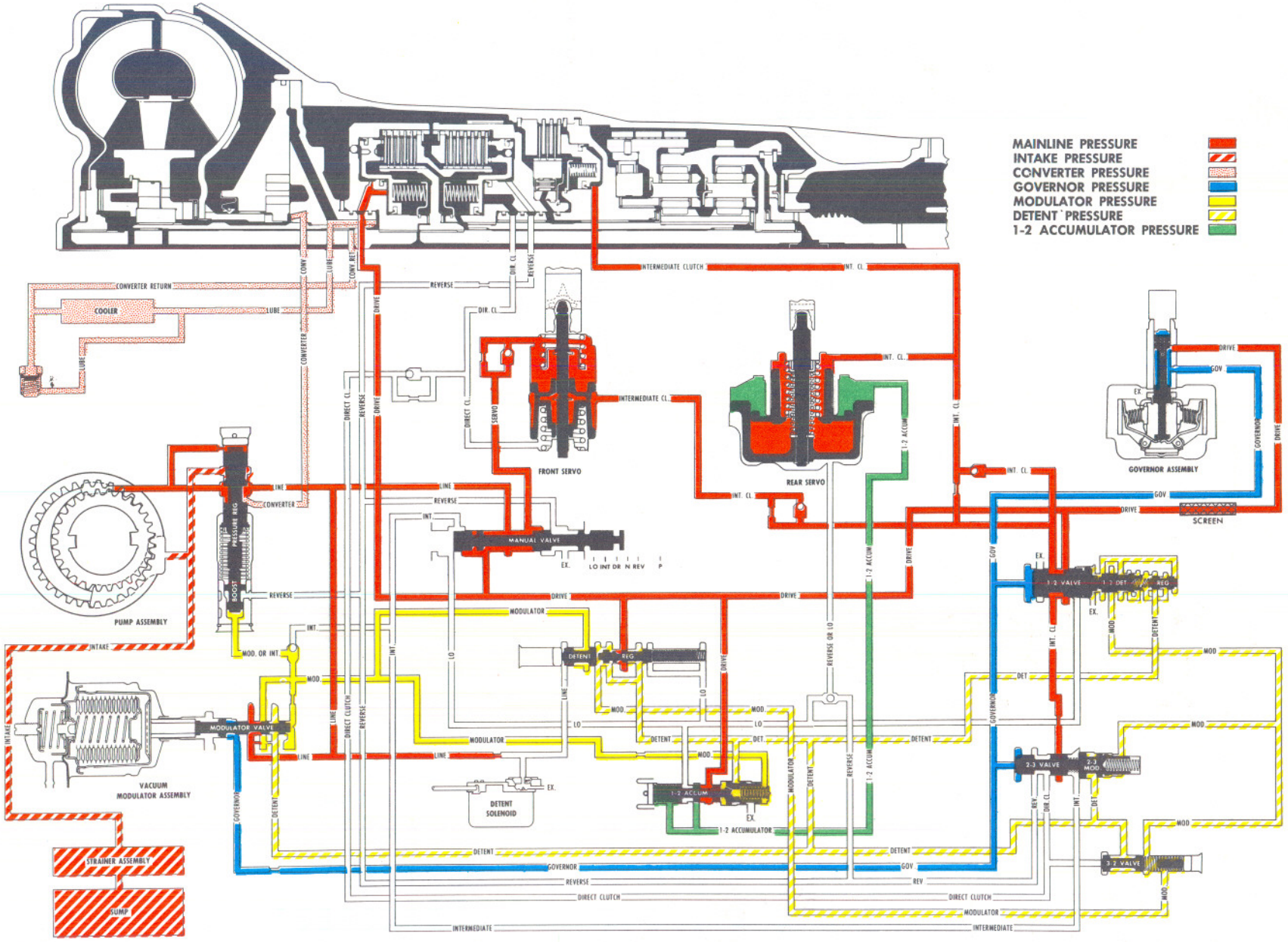


Fig. 7-12 Detent 3-2 Downshift

DRIVE (RIGHT)—SECOND SPEED POWER FLOW

Forward Clutch - Applied

Roller Clutch - Ineffective

Direct Clutch - Released

Front Band - Applied

Rear Band - Released

Intermediate Clutch - Applied

Intermediate Roller Clutch - Effective

In second speed, the intermediate clutch is applied to allow the intermediate roller clutch to hold the sun gear against counterclockwise rotation. Turbine torque through the forward clutch is now applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.48:1.

In second speed - Drive (right), engine braking is provided by the front band as it holds the sun gear fixed. Without the band applied, the sun gear would overrun the intermediate roller clutch.

OIL FLOW (Fig. 7-13)

When the selector lever is in Drive (right), intermediate oil from the manual valve is directed to the:

1. Pressure Boost Valve
2. 2-3 Shift Valve

Intermediate oil at the boost valve will increase line pressure to 150 psi. This increased intermediate oil pressure at the 2-3 shift valve will close the 2-3 shift valve, regardless of car speed.

For engine braking the front band is applied by exhausting servo oil at the manual valve. This allows intermediate clutch oil, acting on the servo piston, to move the piston and apply the front band. Once the transmission is in second speed - Drive (right), it cannot upshift to third gear.

Summary

The forward and intermediate clutches and front band are applied. The transmission is in second gear - Drive (right).

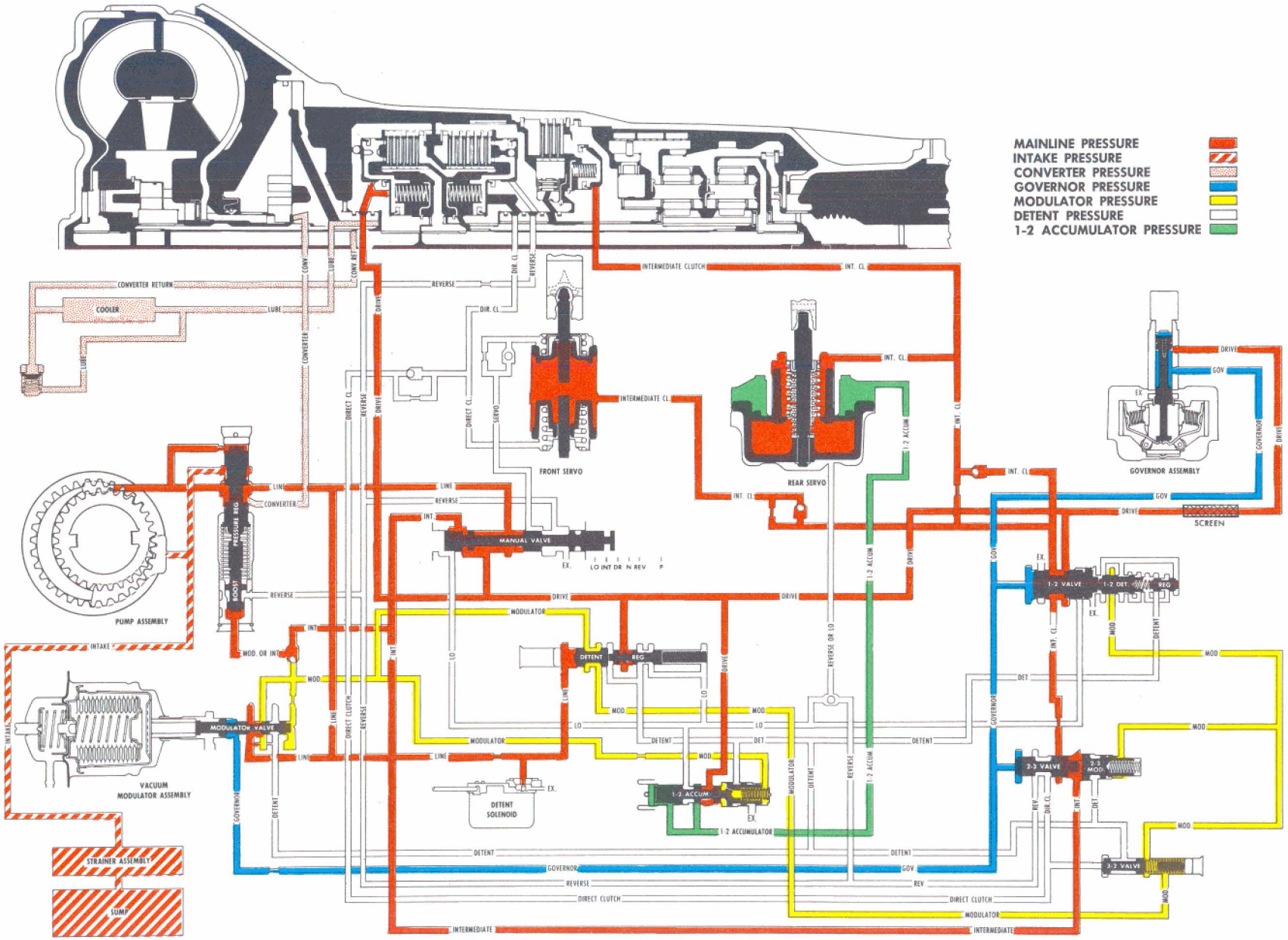


Fig. 7-13 Drive (Right) Second Gear

LO RANGE—FIRST SPEED POWER FLOW

Forward Clutch - Applied

Roller Clutch - Effective

Direct Clutch - Released

Front Band - Released

Rear Band - Applied

Intermediate Clutch - Released

Intermediate Roller Clutch - Ineffective

With the selector lever in Lo range, the forward clutch is applied. This delivers turbine torque to the mainshaft and turns the rear internal gear in a clockwise direction. (Converter torque ratio = approximately 2.00:1 at stall.)

Clockwise motion of the rear internal gear causes the rear pinions to turn clockwise to drive the sun gear counterclockwise. In turn, the sun gear drives the front pinions clockwise, thus turning the front internal gear, output carrier, and output shaft clockwise in a reduction ratio of approximately 2.48:1. The reaction of the front pinions against the front internal gear is taken by the reaction carrier and roller clutch assembly to the transmission case. (Total stall ratio = approximately 5.00:1.)

Downhill or overrun braking is provided in Lo range by applying the rear band, as this prevents the reaction carrier from overrunning the roller clutch.

OIL FLOW (Fig. 7-14)

Maximum downhill braking can be attained at speeds below 40 mph, with the selector lever in Lo position as this directs Lo oil from the manual valve to the:

1. Rear Servo
2. 1-2 Accumulator Valve
3. Detent Regulator Valve
4. 1-2 Shift Valve

Basic Control

Lo oil flows past a check ball to the apply side of the rear servo piston and to the 1-2 accumulator valve to raise the 1-2 accumulator oil to line pressure for a smooth band apply.

Lo oil acts on the detent regulator valve. Combined with the detent spring. Lo oil holds the detent valve against line oil acting on the detent valve, causing drive oil to flow through the detent regulator valve into the detent and modulator passages. Modulator and detent oil at line pressure acting on the 1-2 regulator and 1-2 detent valve overcomes governor oil and Lo oil on the 1-2 shift valve at any vehicle speed below approximately 40 mph, and the transmission will shift to first gear.

In first speed - Lo range, the transmission cannot upshift to second speed regardless of vehicle or engine speed.

Summary

The forward clutch and rear band are applied. The transmission is in first speed - Lo range.

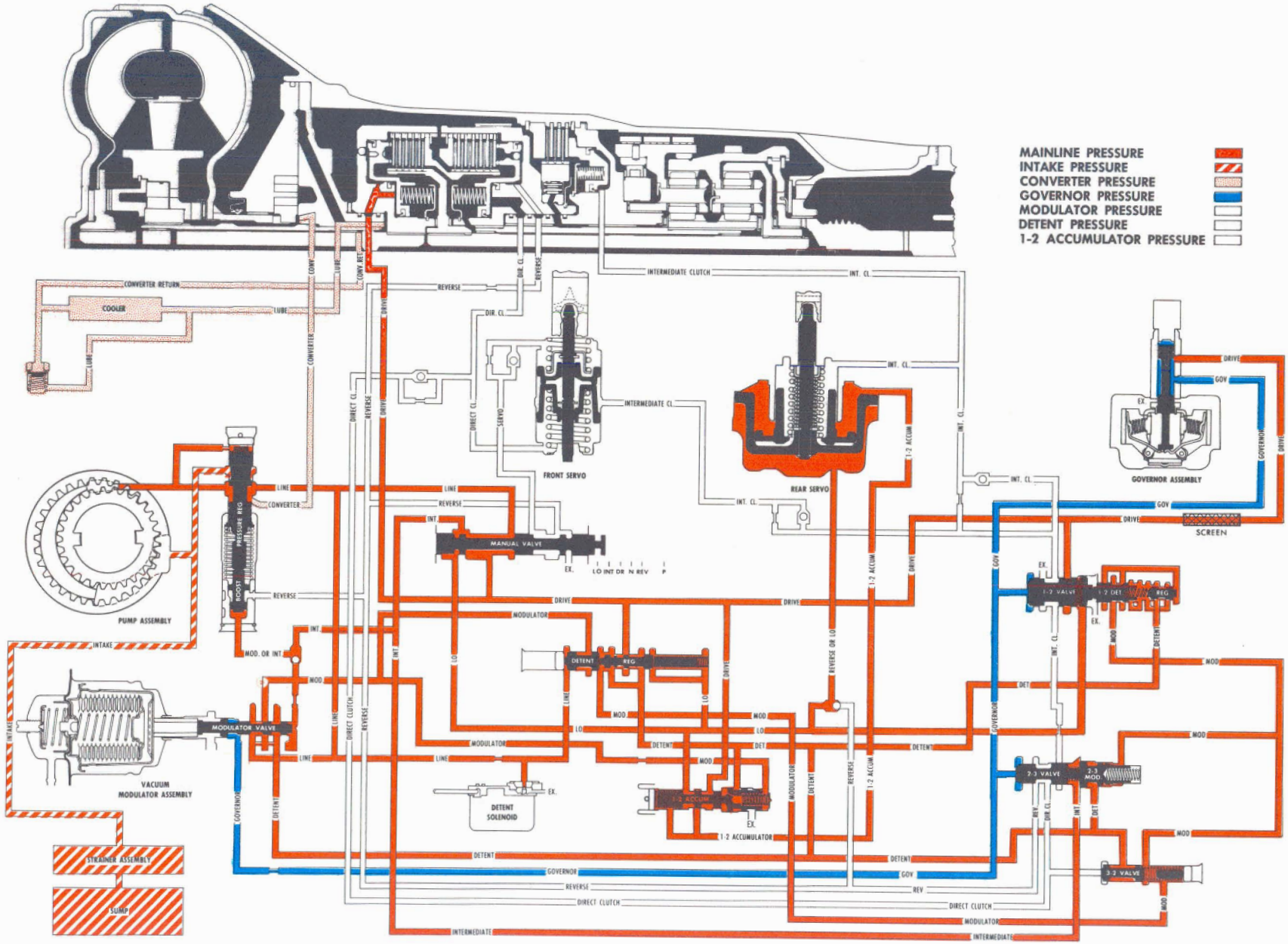


Fig. 7-14 Lo Range - First Gear

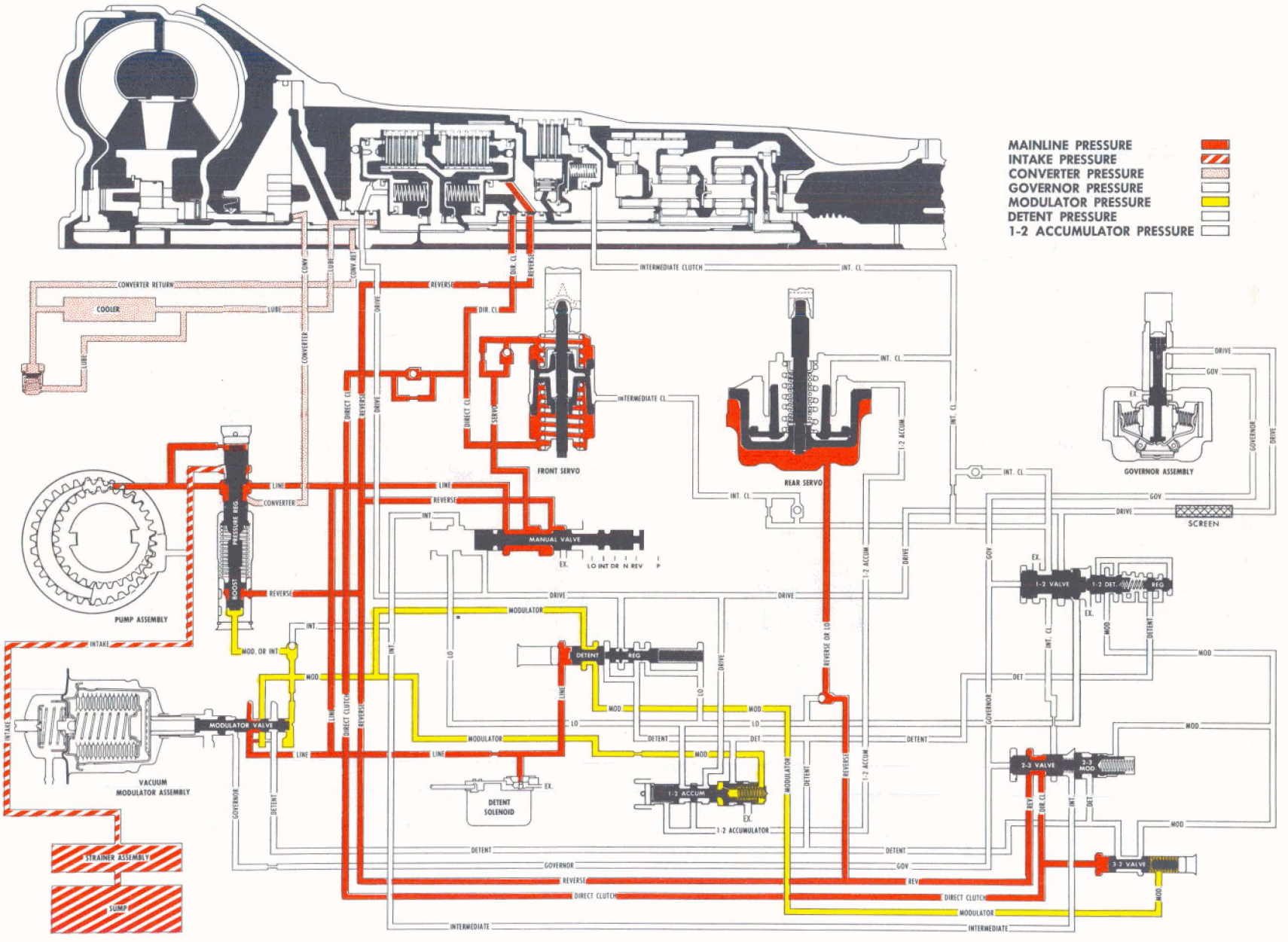


Fig. 7-15 Reverse

REVERSE POWER FLOW

Forward Clutch - Released

Roller Clutch - Ineffective

Direct Clutch - Applied

Front Band - Released

Rear Band - Applied

Intermediate Clutch - Released

Intermediate Roller Clutch - Ineffective

In Reverse, the direct clutch is applied to direct turbine torque to the sun gear shaft and sun gear. The rear band is also applied, holding the reaction carrier.

Clockwise torque to the sun gear causes the front pinions and front internal gear to turn counterclockwise in reduction. The front internal gear is connected directly to the output shaft, thus providing the reverse output gear ratio of approximately 2.08:1. The reverse torque multiplication at stall (converter and gear ratios) is approximately 4.00:1.

OIL FLOW (Fig. 7-15)

When the selector lever is moved to the Reverse position, the manual valve is repositioned to allow line pressure to enter the reverse circuit. Reverse oil then flows to the:

1. Direct Clutch
2. 2-3 Shift Valve
3. Rear Servo Piston
4. Pressure Boost Valve

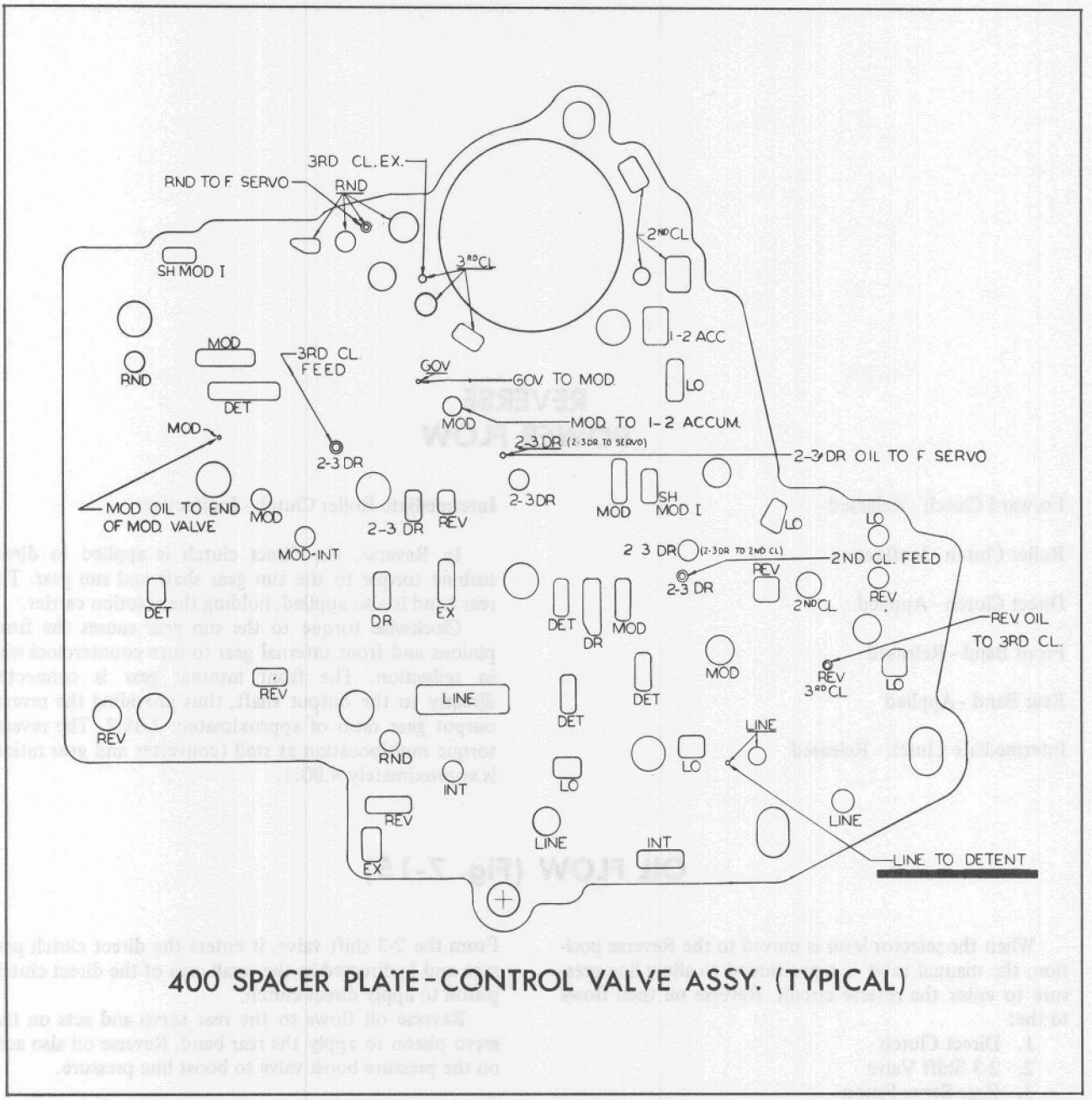
Basic Control

Reverse oil from the manual valve flows to the large area of the direct clutch piston and to the 2-3 shift valve. From the 2-3 shift valve, it enters the direct clutch passage and is directed to the small area of the direct clutch piston to apply direct clutch.

Reverse oil flows to the rear servo and acts on the servo piston to apply the rear band. Reverse oil also acts on the pressure boost valve to boost line pressure.

Summary

The direct clutch and the rear band are applied. The transmission is in Reverse.



400 SPACER PLATE-CONTROL VALVE ASSY. (TYPICAL)

Fig. 7-16 Spacer for Control Valve Assembly

SERVICE INFORMATION

1. Fluid Leakage Precautions

The precautions that must be observed to prevent fluid leaks are as follows:

1. Use new gaskets and O-ring seals whenever there is a disassembly.
2. Use a very small amount of petrolatum to hold gaskets and thrust washers in place during assembly, or to seal gaskets. Never use gasket paste or shellac.
3. Make sure that composition cork and paper gaskets are not wrinkled or creased when installed. Make sure that gaskets have not stretched or shrunk during storage.
4. Make sure the square type O-ring seals are installed squarely and are not twisted during assembly.
5. Make sure that mating surfaces of castings are flat and smooth, free of deep scratches, chips, and burrs.
6. Torque bolts to proper torque.

2. Points of Possible Oil Leaks

When checking for oil leaks, first determine whether

leak originates from transmission or engine. The original factory fill fluid in the transmission is formulated with a red aniline dye to assist in locating leaks. If the color of the dye cannot be detected in the transmission fluid, the fluid should be changed. Red dye appearing in the leaking oil will give positive identification as to the location of the leak.

If oil leak is found to be in transmission, check for leak in following areas:

a. Front End

It will be necessary to remove lower cover at front of transmission case to determine location of leaks at front end. To correct leaks at front end, it will be necessary to remove transmission from car.

1. Pump oil seal leak - Check pump oil seal to make certain it is correctly installed and not damaged.

When installing a new pump oil seal, Note 13, make certain that bore is free from foreign material and that garter spring on seal is correctly positioned. Check finish of converter neck and bearing surface in pump body.

2. Pump assembly-to-case square cut O-ring or gasket damaged.
3. Rubber coated-washers on pump attaching screws damaged or missing.
4. Converter - Inspect converter for indications of leakage. See Note 14, for checking procedure.

b. Extension Housing

1. Extension housing oil seal not installed properly or damaged.
2. Gasket (extension housing-to-case) improperly installed or damaged.
3. Extension housing-to-case attaching screws not torqued to specifications. Tighten to 23 foot-pounds.
4. Porous or cracked casting.
5. Propeller shaft front slip yoke scratched or corroded.
6. O-ring on output shaft, improperly installed or damaged.

c. Transmission Case

1. Speedometer driven gear housing retainer attaching screw loose. Tighten to 18 foot-pounds.
2. Speedometer driven gear housing O-ring or lip seal damaged.
3. Speed controlled spark switch or transmission speed sensor loose.
4. Governor cover attaching screws not tight. Tighten screws to 18 foot-pounds.
5. Damaged governor gasket.
6. Electrical connector O-ring damaged.
7. Parking pawl shaft cup plug not properly installed.
8. Manual shaft seal damaged.
9. Vacuum modulator damaged.
10. Vacuum modulator retainer screw loose. Tighten to 18 foot-pounds.
11. Vacuum modulator diaphragm damaged.

(NOTE: A ruptured diaphragm would allow transmission oil to be drawn into intake manifold and vacuum line. Usually the exhaust will be excessively

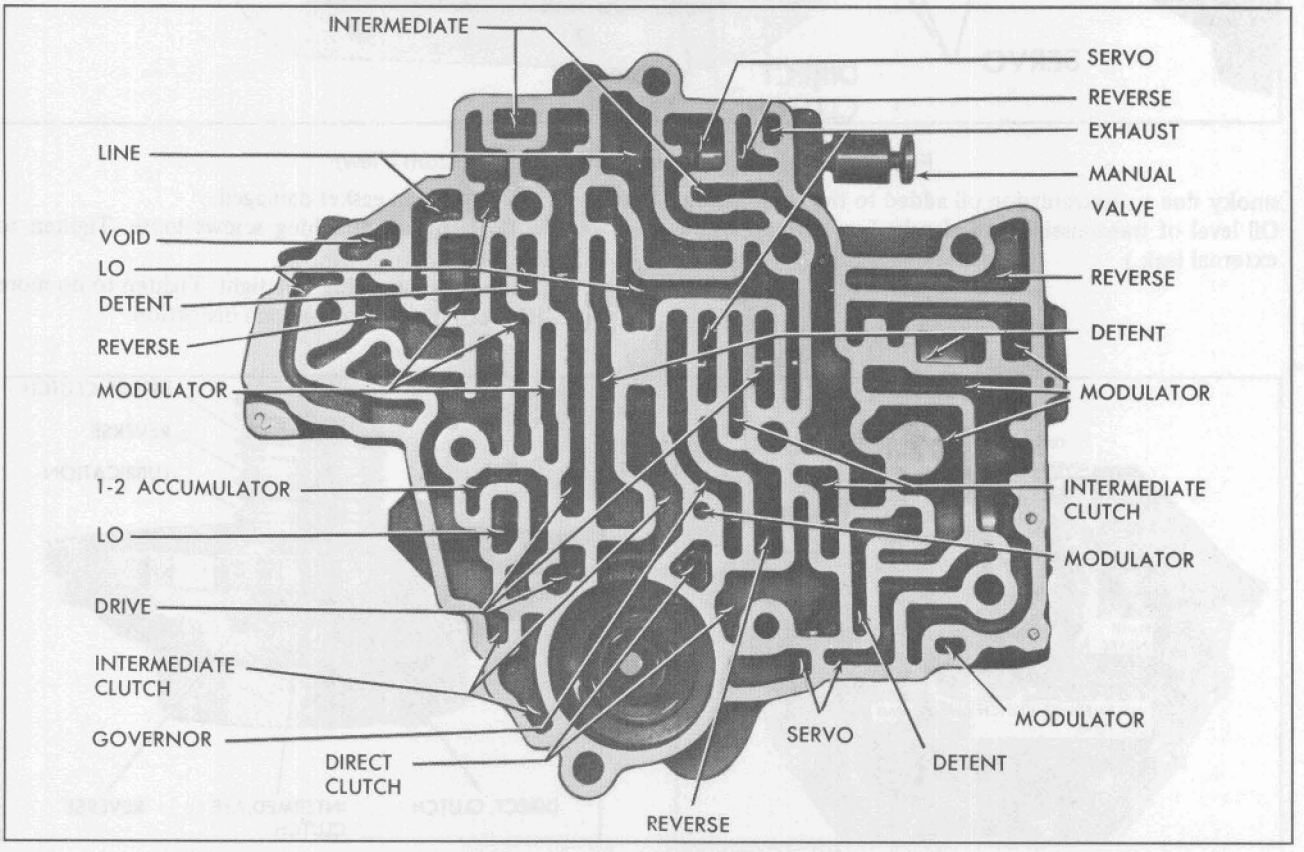


Fig. 7-17 Control Valve Body Oil Passages

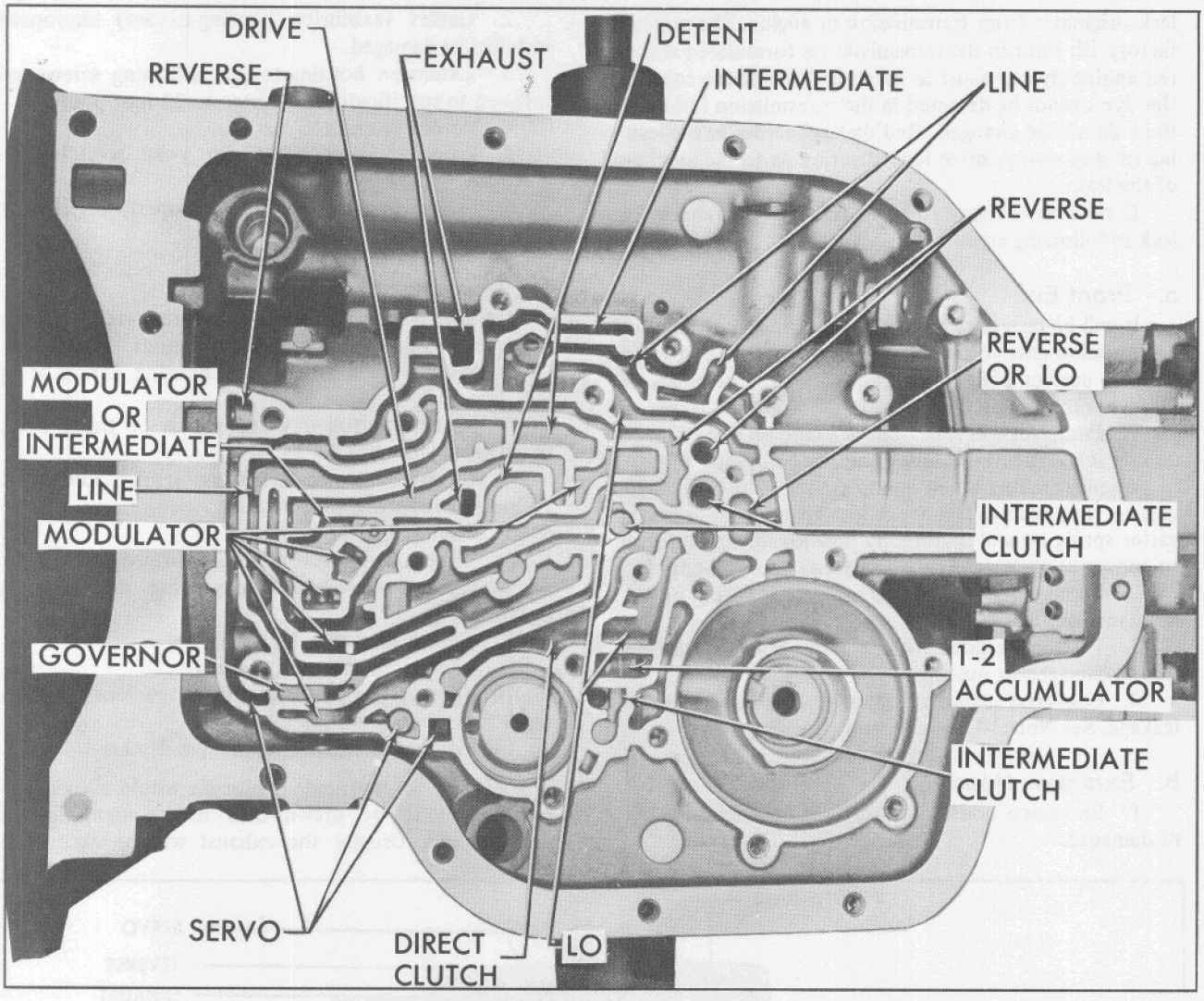


Fig. 7-18 Transmission Case Oil Passages (Bottom View)

smoky due to transmission oil added to the combustion. Oil level of transmission will also be low with no visible external leak.)

12. Bottom pan gasket damaged.

13. Bottom pan attaching screws loose. Tighten to 12 foot-pounds.

14. Line pressure plug not tight. Tighten to no more than 10 foot-pounds to avoid pan distortion.

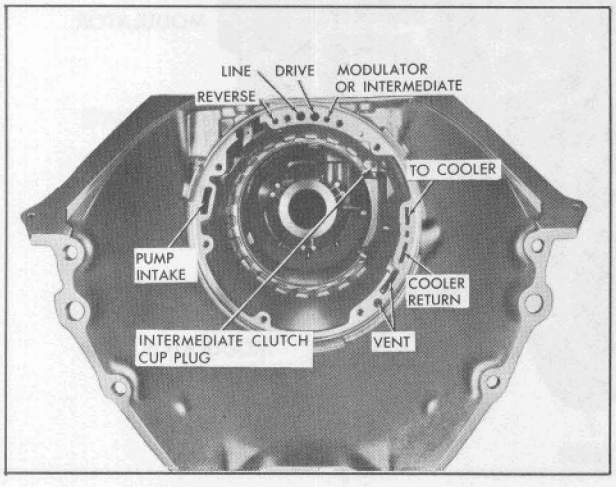


Fig. 7-19 Transmission Case Oil Passages

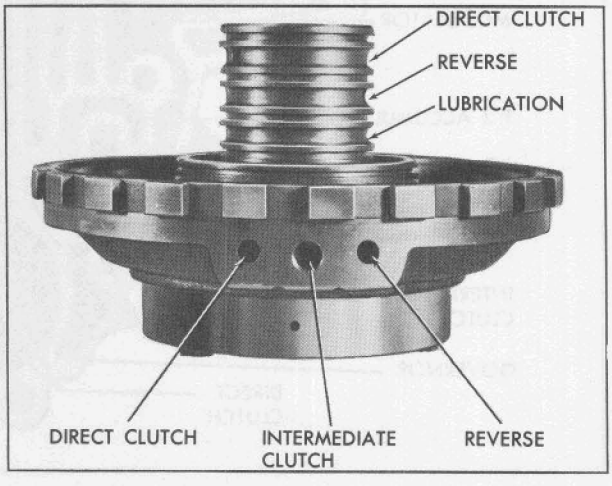


Fig. 7-20 Center Support Oil Passages

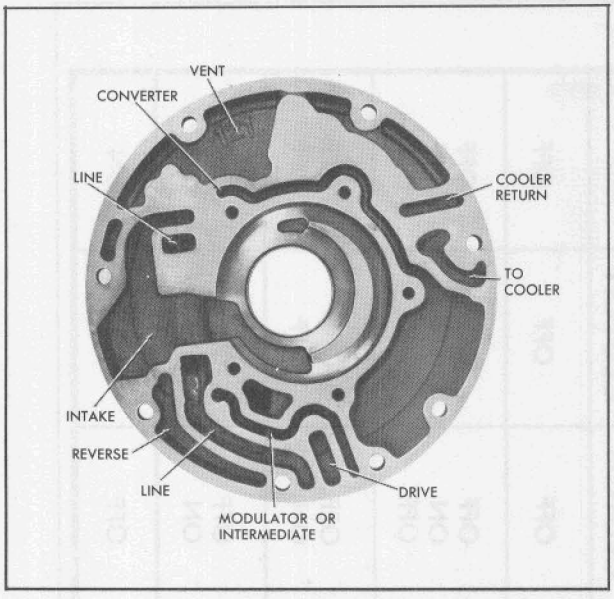


Fig. 7-21 Pump Body Oil Passages

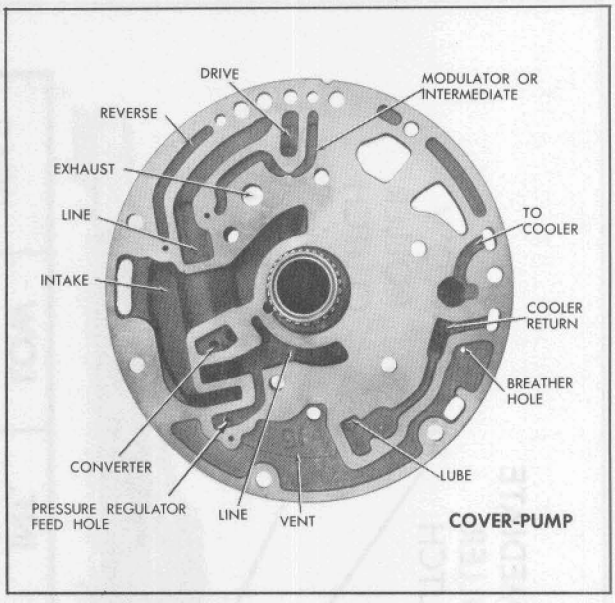


Fig. 7-22 Pump Cover Oil Passages

15. Porous or cracked casting.
16. Vent pipe.
a. Transmission over-filled
b. Water in oil.
c. Pump to case gasket mispositioned.
d. Foreign material between pump and case, or between pump cover and body.
e. Case - Porous pump face improperly machined.

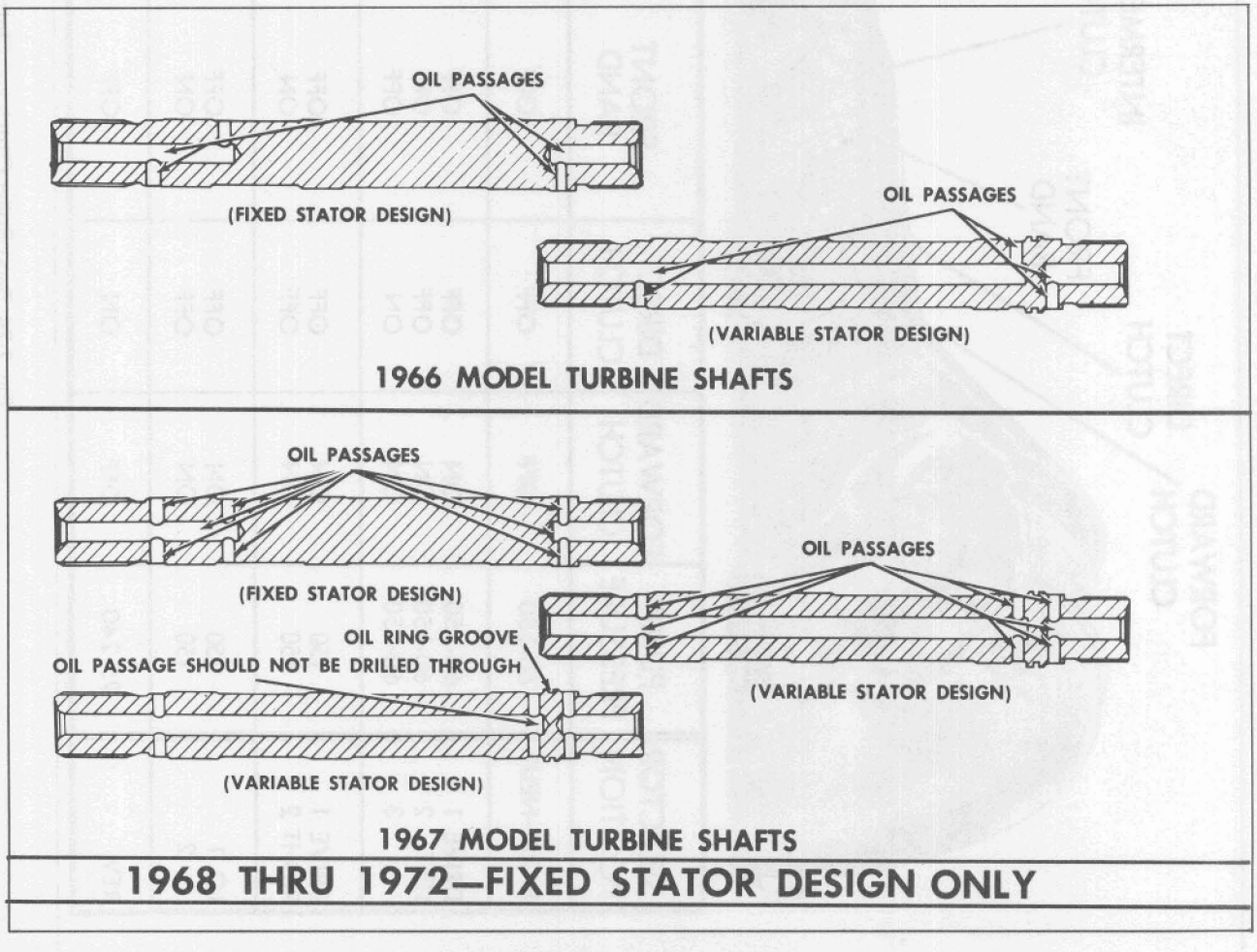
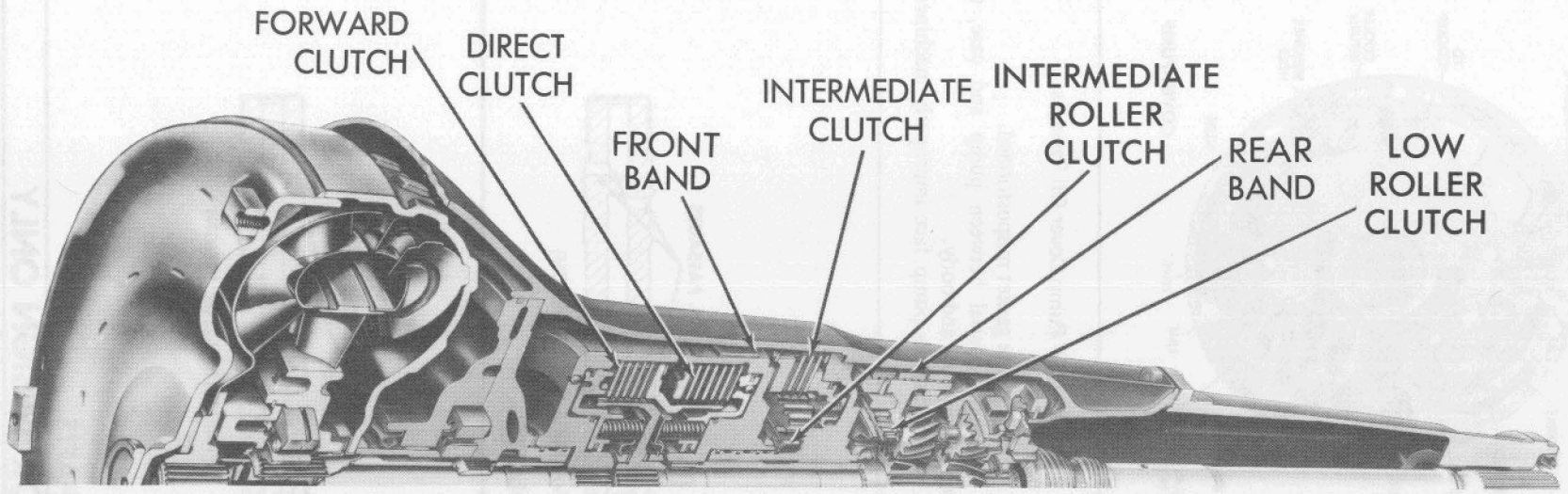


Fig. 7-23 Turbine Shafts



SELECTOR POSITION	PUMP PRESSURE	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INT. CLUTCH	INT. ROLLER CLUTCH	LOW ROLLER CLUTCH	REAR BAND
PARK—NEUT.	60-150	OFF	OFF	OFF	OFF	OFF	OFF	OFF
DRIVE 1	60-150	ON	OFF	OFF	OFF	OFF	ON	OFF
LEFT 2	60-150	ON	OFF	OFF	ON	ON	OFF	OFF
3	60-150	ON	ON	OFF	ON	OFF	OFF	OFF
DRIVE 1	150	ON	OFF	OFF	OFF	OFF	ON	OFF
RIGHT 2	150	ON	OFF	ON	ON	ON	OFF	OFF
LO 1	150	ON	OFF	OFF	OFF	OFF	ON	ON
2	150	ON	OFF	ON	ON	ON	OFF	OFF
REV.	95-240	OFF	ON	OFF	OFF	OFF	OFF	ON

Fig. 7-24 Band Roller Clutch and Clutch Application Chart

f. Pump - Shy of stock, porous. Breather hole in pump cover plugged.

g. Cut O-ring or intake or grommet on filter assembly.

d. Oil Cooler Pipe Connections

1. Outside oil cooler pipe connections improperly installed or damaged. Also connectors in radiator and transmission.

2. Oil cooler pipe connections not tight. Tighten to 23 foot-pounds on 5/16" pipes and 25 foot-pounds on 3/8" pipes.

3. Flare on oil cooler pipes damaged at radiator or transmission.

e. Filler Pipe

1. O-ring damaged or improperly installed on pipe.

2. Filler pipe not fully seated in case.

f. Internal Leaks

It will be necessary to remove bottom pan to determine location of internal leaks.

1. Governor pipes damaged.

2. Rear servo cover attaching screws not tight. Tighten to 18 foot-pounds.

3. Rear servo cover gasket damaged.

4. Control valve assembly spacer plate-to-case gasket damaged.

5. Control valve assembly attaching screws loose. Tighten to 8 foot-pounds.

6. Solenoid gasket damaged.

7. Solenoid attaching screws loose. Tighten to 8 foot-pounds.

8. Intake pipe O-ring or filter grommet damaged causing a foaming condition.

9. Rear servo square cut O-ring improperly installed or damaged.

DIAGNOSIS

3. Turbo Hydra-Matic 400 Diagnosis Procedure

(NOTE: The following information, unless specifically noted elsewhere, is not applicable to the Eldorado.)

CAUTION: In the event of a major transmission failure, replace filter assembly, flush oil cooler and lines. This is particularly important in the case of a converter failure.

3a. How to Use This Diagnosis Guide

This Diagnosis Guide should be used in the following sequence to positively locate the problem:

1. Perform the "Preliminary Checking Procedure" in Part b, recording the readings in the Oil Pressure Reading row. After taking the pressure readings, place Low, Normal or High in each box of the Oil Pressure Pattern row.

2. Road test the car as described in Part c, if problem is not known.

3. Refer to the "Transmission Malfunction Related to Oil Pressure" chart in Part d. First, determine if malfunction noted is in this chart. If so, compare Oil Pressure Pattern row in Part b with Part d. A dash on the "Transmission Malfunction Related to Oil Pressure" chart means that the oil pressure reading has no significance under the test condition.

If transmission malfunction is found in this chart, follow the directions indicated in the Malfunction column. The oil pressure pattern will indicate where the malfunction is.

The only time it is necessary to determine a pressure drop (the control valve assembly-governor line pressure check, part m) is when there is "No 1-2 Upshift and/or Delayed Upshift" and all oil pressure readings are normal.

It will not be necessary to repeat oil pressure readings taken during preliminary checks should this be called for during further tests.

4. If malfunction cannot be determined by the chart in Part d, or if upon completion of these tests, it is not found, see the "Transmission Troubleshooting Guide", in Part e, to locate malfunction not related to oil pressure.

All malfunctions, both those related to oil pressure and those that are not, are listed in the "Transmission Troubleshooting Guide". Always perform the "Preliminary Checking Procedure" first as it provides a positive means to isolate the problem if the malfunction can be diagnosed by this procedure.

5. After correcting malfunction, road test car as described in Part c.

(NOTE: This information pertains to all Cadillac transmissions. For additional illustrations on the Eldorado transmission, see the later portion of this section.)

3b. Preliminary Checking Procedure

(See page 7-31).

3c. Transmission Road Testing

1. Connect portable tachometer to engine. Engine rpm will identify shift points.

2. Place selector in "Drive Left" position and accelerate the vehicle from rest at a minimum throttle opening. The specifications for shift points are:

Upshift	Maximum
1-2	15 mph
2-3	30 mph

Accelerate the vehicle from rest at wide-open throttle. The specifications for shift points are:

Upshift	Except 693	693 Style
	Maximum	
1-2	53 mph	50 mph
2-3	88 mph	85 mph
Detent Downshifts		
3-2	75 mph	72 mph
2-1	28 mph	25 mph

Downshifts should occur (3-2 and 2-1) as the vehicle speed decreases to 0 mph. Stop car.

3. Place selector in "Drive Right" position and accelerate the vehicle from rest. A 1-2 shift should occur at all throttle openings. No 2-3 shift can be obtained in this range. Stop car.

4. Place selector in "Low". No upshift should occur in this range regardless of the throttle opening.

5. Position the selector in "Drive Left" and accelerate the vehicle to 35 mph and move the selector to "Drive Right". A 3-2 downshift should occur, increasing the engine rpm and an engine braking effect should be noticed on deceleration.

6. With the selector in "Drive Right" at approximately 25 mph, but not over 40 mph, at closed throttle, move the selector to "Low". A 2-1 downshift should occur, increasing the engine rpm and an engine braking effect should be noticed on deceleration. Stop car.

7. Place selector in "Reverse" and check for reverse operation.

3b. Preliminary Checking Procedure

CHECK TRANSMISSION OIL LEVEL
SEE NOTE 6 or 24.

CHECK MANUAL LINKAGE AND CORRECT.
SEE NOTE 4 or 21.

INSTALL OIL PRESSURE GAGE

CHECK OIL PRESSURE IN FOLLOWING MANNER

CAUTION: Total Running Time for This Combination Not to Exceed 2 Minutes.

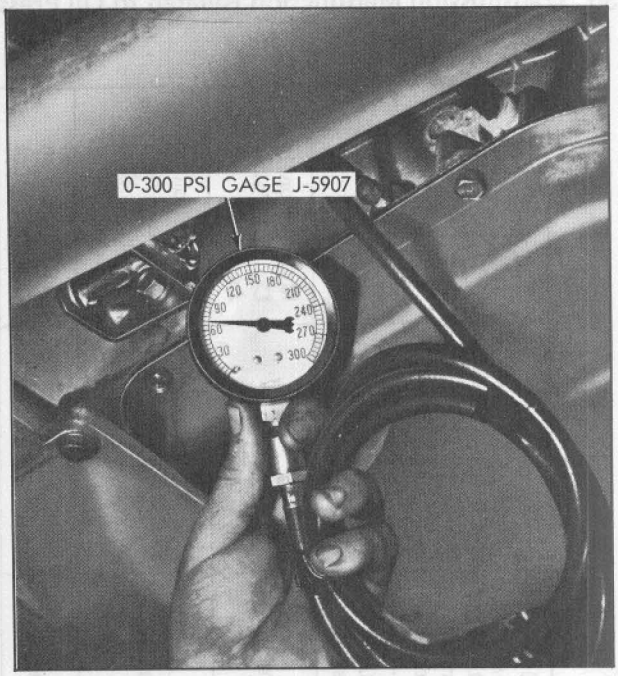


Fig. 7-25 Oil Pressure Test Gage

Range	Drive (Left) Brakes Applied Engine at 1000 RPM	Drive-R Brakes Applied Engine at 1000 RPM	Reverse Brakes Applied Engine at 1000 RPM	Neutral Brakes Applied Engine at 1000 RPM	Drive Idle Set Engine Idle to Specifications	*Drive 30 MPH Closed Throttle
Oil Pressure Reading						
Normal P.S.I.	60 to 90	135 to 160	95 to 150	55 to 70	60 to 85	55 to 70
Oil Pressure Pattern - Low, Normal or High						

*The following alternate check may be used to obtain this pressure reading and permit all the required pressure checks to be made without the necessity of a road test.

1. Vehicle on hoist - driving wheels off ground, foot off brake, in Drive Range.
2. Engine 2000 RPM.
3. Close throttle (foot off accelerator) and take pressure reading engine 2000 - 1200 RPM.

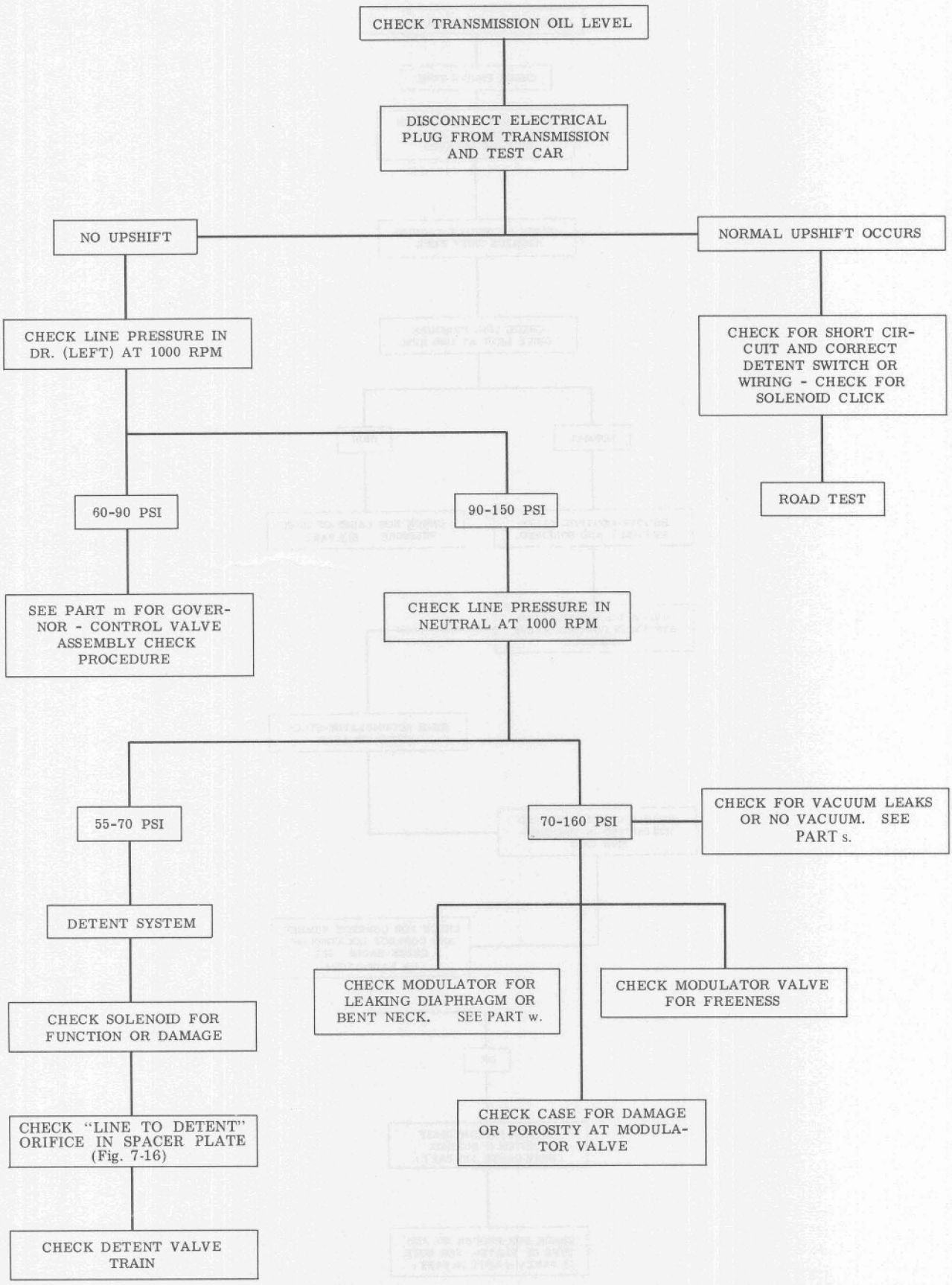
NOTE: With closed throttle and driving wheels off the ground, engine RPM will drop rapidly. Pressure reading must be taken within RPM's indicated and with closed throttle.

3d. Transmission Malfunction Related to Oil Pressure

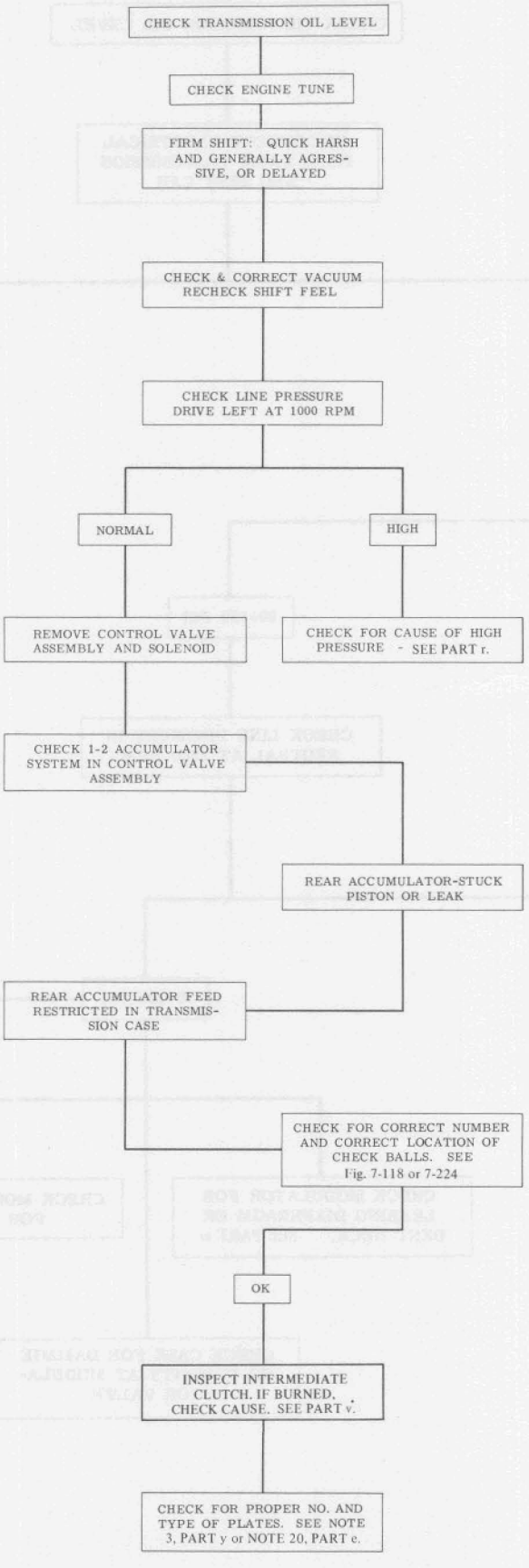
Malfunction	Drive (Left) Brakes Applied 1000 RPM	Drive-R Brakes Applied 1000 RPM	Reverse Brakes Applied 1000 RPM	Neutral Brakes Applied 1000 RPM	Drive Idle	Drive 30 MPH Closed Throttle or Alternate Check	Pressure Drop Occurs While Engine RPM Increases From 1000 to 3000 RPM in Drive Range Wheels Free to Move and Vacuum Modulator Line Disconnected	Possible Cause of Malfunction
	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure		
No 1-2 Upshift and/or Delayed Upshift Compare Preliminary Pressure Reading and See Part f.	Normal	Normal	Normal	Normal	Normal	Normal	Drop	Malfunction in Control Valve Assy.
	Normal	Normal	Normal	Normal	Normal	Normal	No Drop	Malfunction in Governor or Governor Feed System
	High	Normal	Normal	Normal	-	High	-	Malfunction in Detent System
	High	Normal	High	High	-	-	-	Malfunction in Modulator or Vacuum Feed System to Modulator
Slipping-Reverse See Trouble-shooting Guide	Normal	Normal	Low	Normal	-	Normal	-	Oil Leak in Feed System to the Direct Clutch
Slipping-1st Gear. See Trouble-shooting Guide	Low	Low to Normal	Normal	Low to Normal	-	Low to Normal	-	Oil Leak in Feed System to the Forward Clutch
*Downshift with Zero Throttle and No Engine Braking in Drive	** Normal	Normal	Normal	Normal	High	High	-	Stator and Detent Wires switched

*Applicable only to variable stator transmissions, not to any 1968 through 1972 models.
**1966 Cadillac, with brakes applied, will show high if wires are switched.

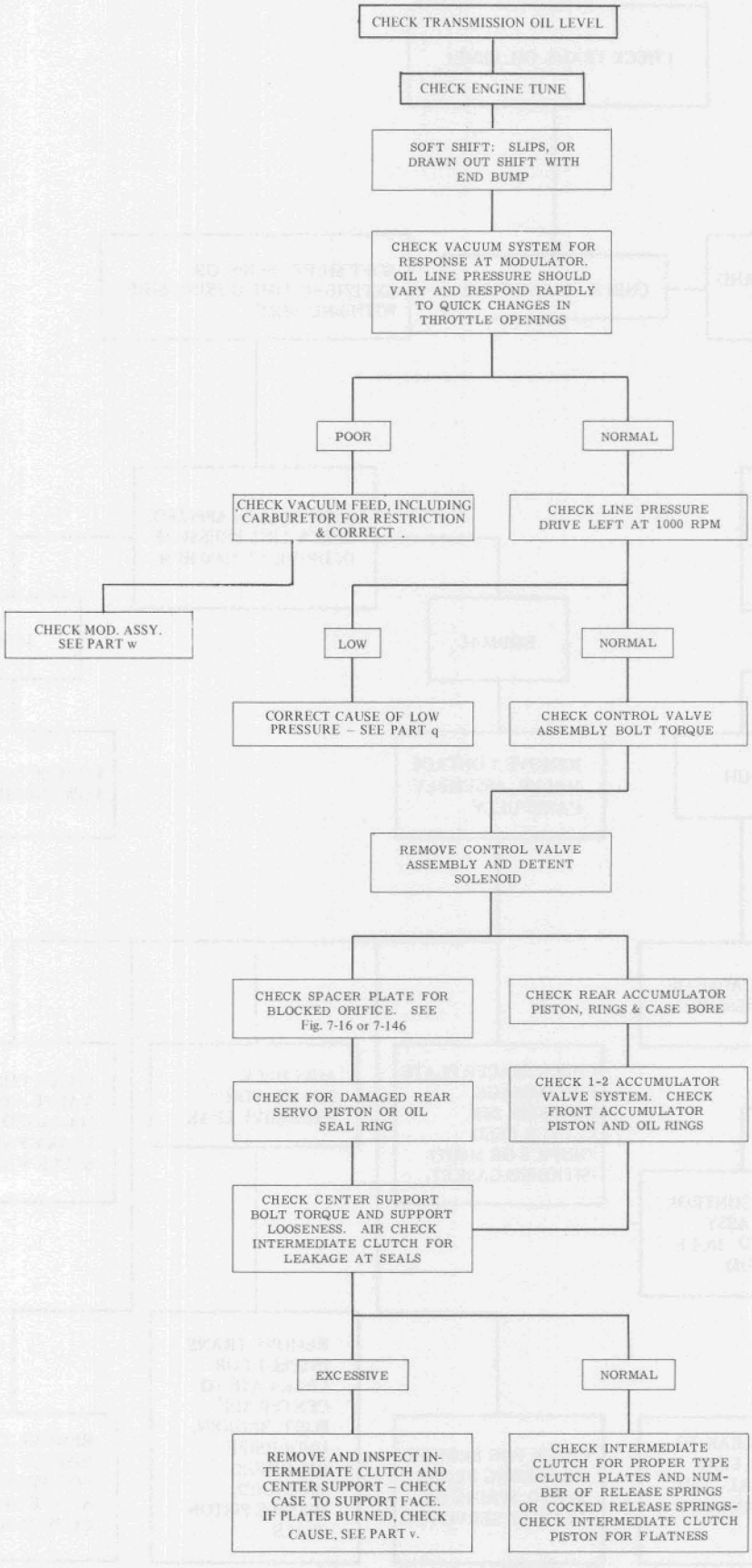
3e. No 1-2 Upshift and/or Delayed Upshift



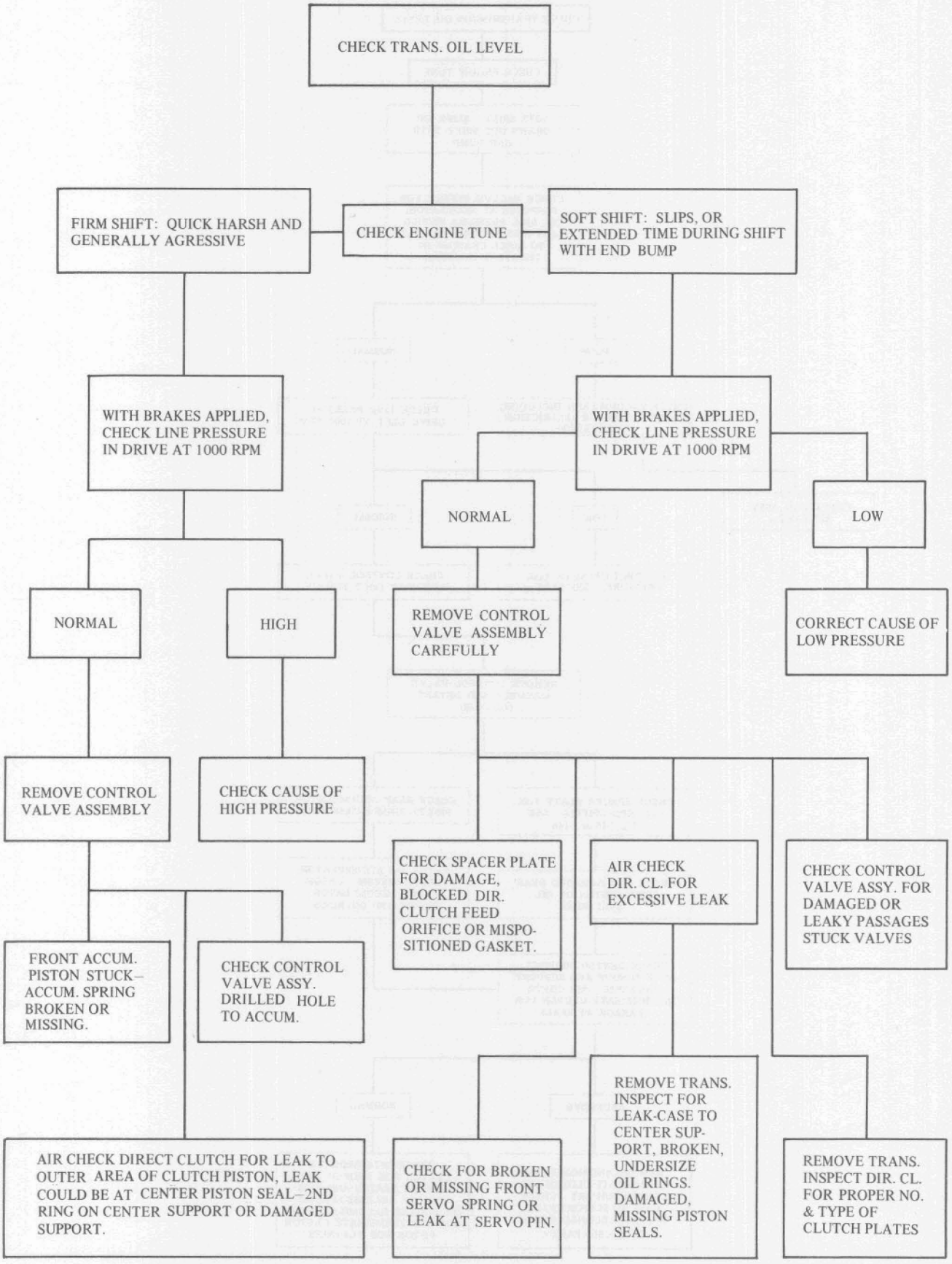
3f. 1-2 Shift Feel Complaint—Firm Shift



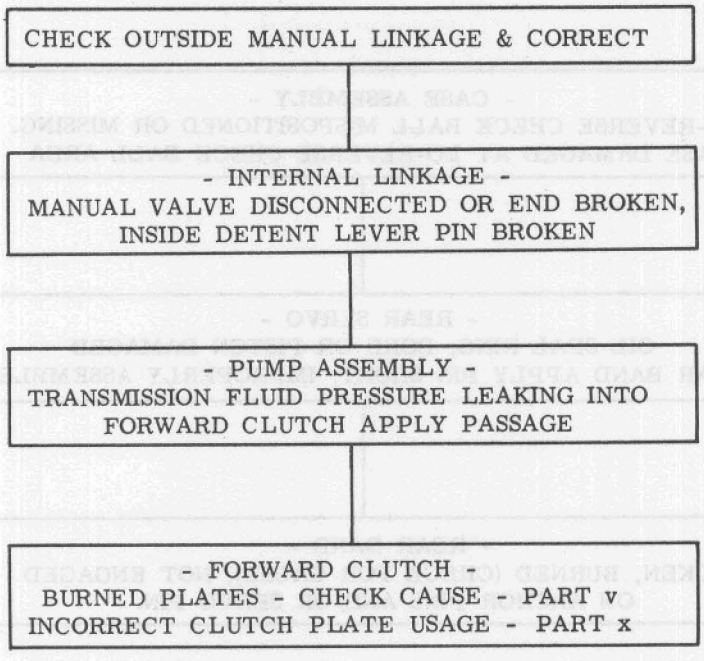
3f. 1-2 Shift Feel Complaint–Soft Shift



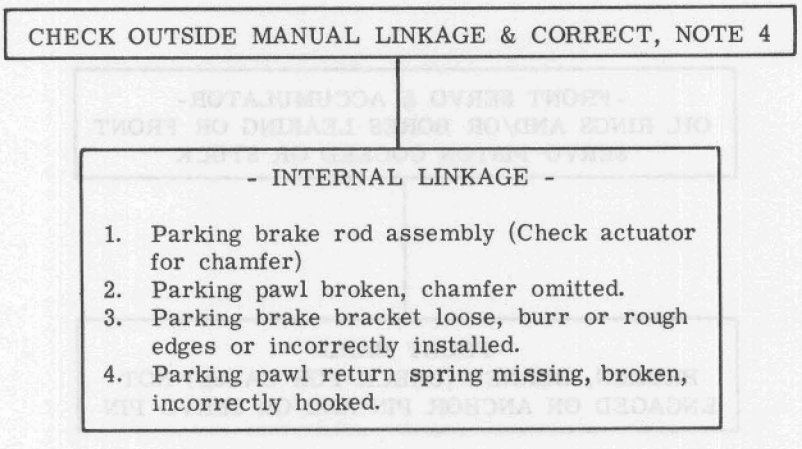
3g. 2-3 Shift Complaint



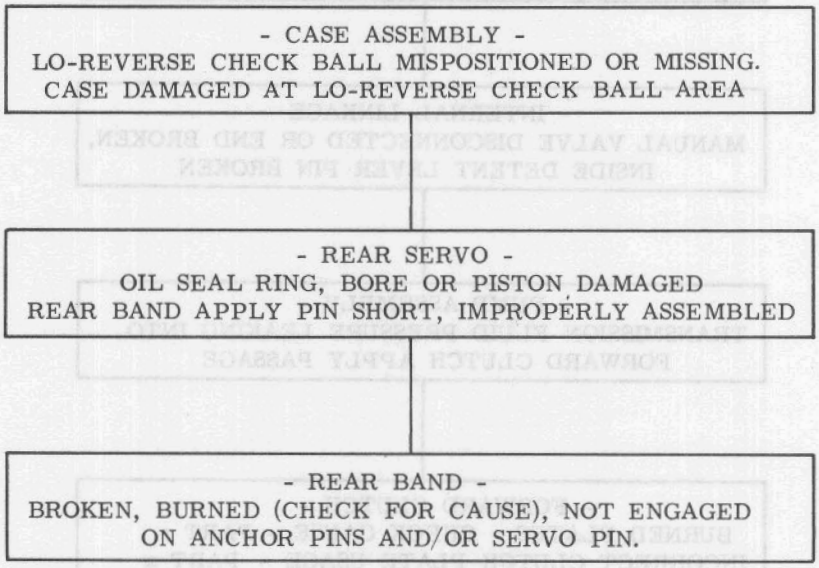
3h. Drive in Neutral



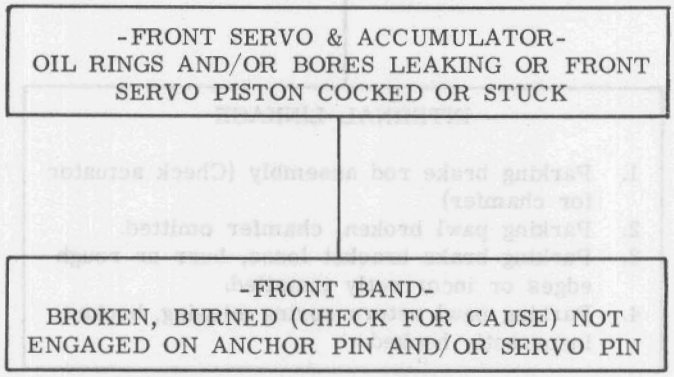
3i. Will not Hold in Park or Will Not Release from Park



3j. No Engine Braking–Lo Range–1st Gear



3k. No Engine Braking–Intermediate Range–2nd Gear



3l. No Reverse or Slips in Reverse

CHECK TRANSMISSION OIL LEVEL – NOTE 6

CHECK OUTSIDE MANUAL LINKAGE & CORRECT - NOTE 4

WITH BRAKES APPLIED, CHECK LINE PRESSURE IN REVERSE @ 1000 RPM

NORMAL

- CONTROL VALVE ASSEMBLY -

1. 2-3 Valve train stuck open (This will also cause a 1-3 upshift in drive range)
2. Reverse feed passage - Cross channel leak, porosity in case or valve body passage, gaskets leaking.

- REAR SERVO & ACCUMULATOR -

1. Servo piston seal ring damaged or missing
2. Short band apply pin (This may also cause no overrun braking or slips in overrun braking-lo range)
   Refer to Shop Manual for pin selection
3. Rear servo piston or bore.

- FORWARD CLUTCH -
Clutch does not release (will also cause Drive in Neutral)

- DIRECT CLUTCH BURNED -
Check cause - PART v

- REAR BAND -
Broken, burned, loose lining, apply pin or anchor pins not engaged.

CENTER SUPPORT
Oil seal rings or grooves damaged or worn.

LOW

CORRECT CAUSE - PART q

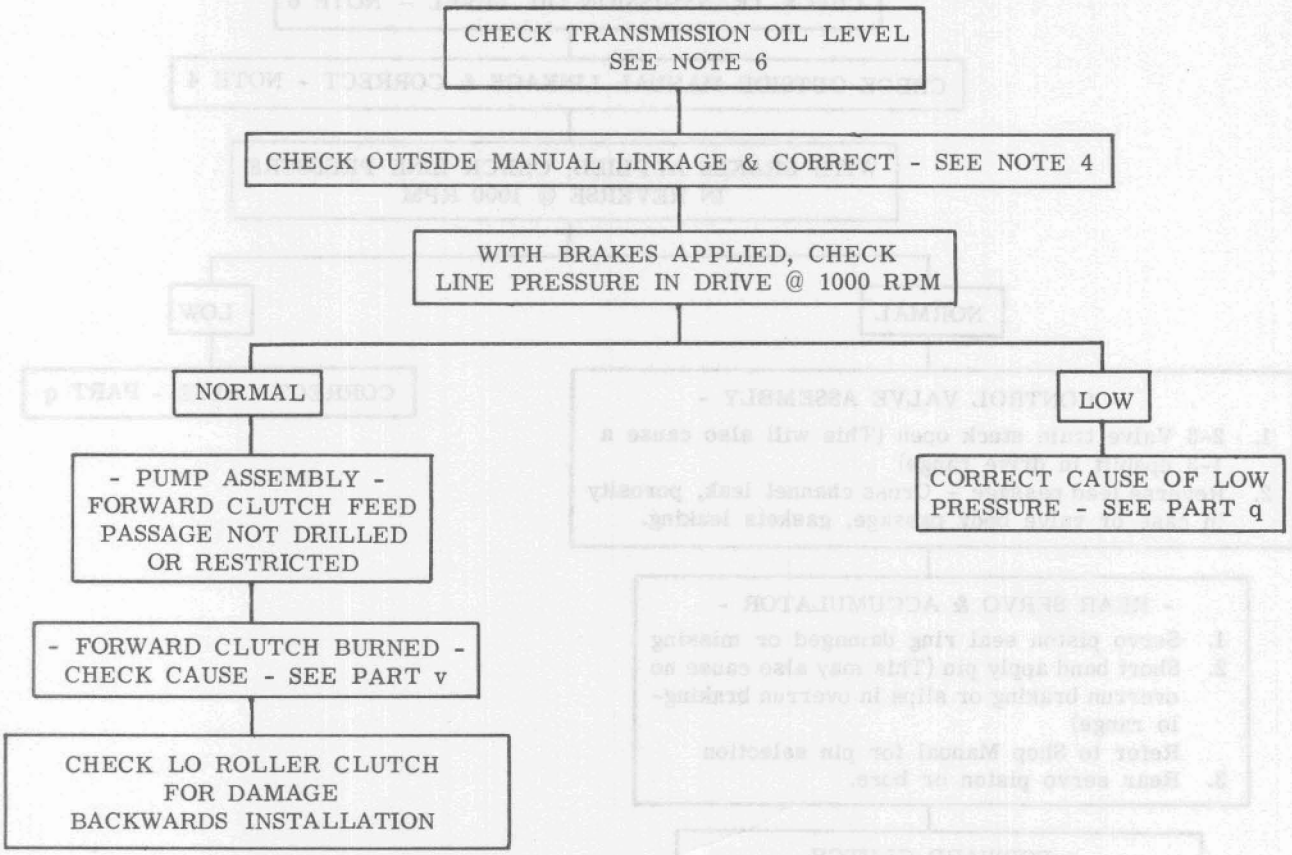
3m. 1st and 2nd Speeds Only, No 2-3 Upshift

- CONTROL VALVE ASSEMBLY -
STUCK 2-3 VALVE, GASKET MISPOSITIONED OR LEAKING

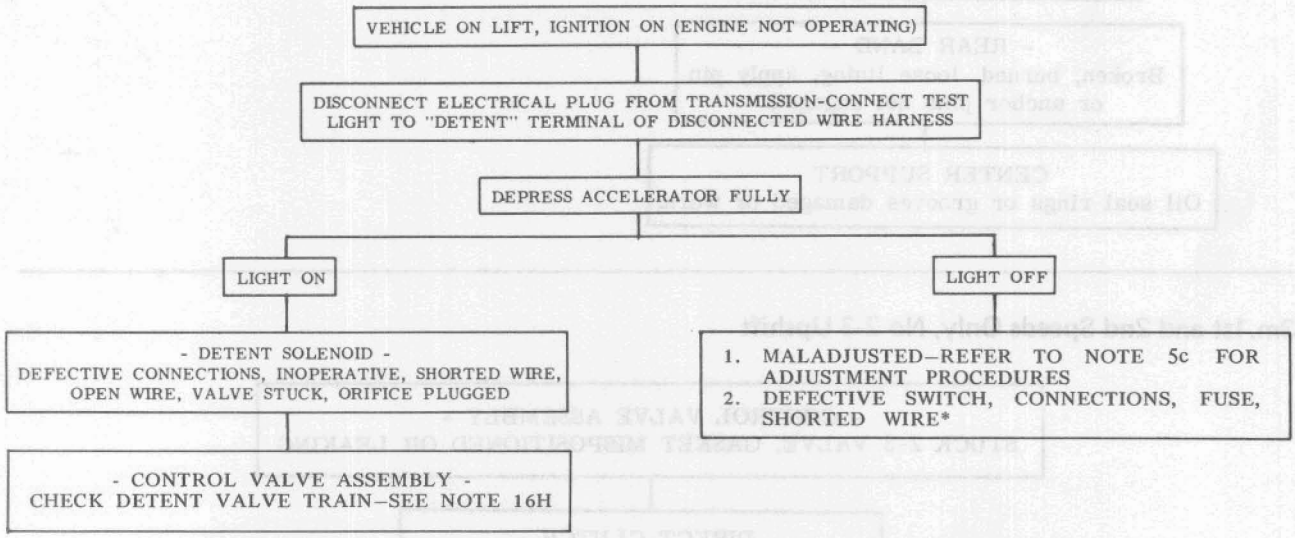
- DIRECT CLUTCH -
BURNED, CHECK CAUSE - Part v

- IMPROPER VACUUM -
CHECK CAUSE, PART s

3n. No Drive in Drive Range

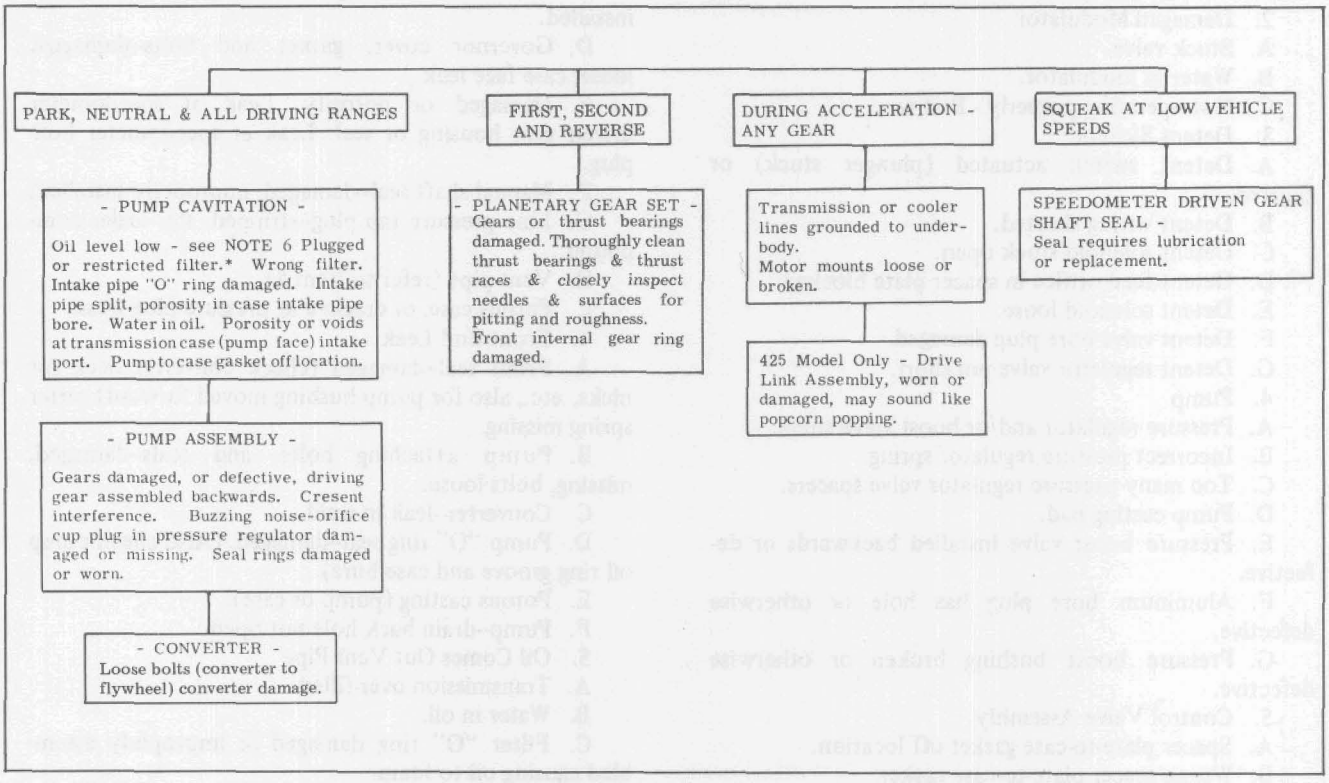


3o. No Detent Downshifts



3p. Transmission Noisy

(NOTE: Before checking transmission for what is believed to be "Transmission Noise," make certain the noise is not from the water pump, generator, air conditioner, power steering. etc. These components can be isolated by removing the proper belt and running the engine no more than two minutes at one time.)



*There is no approved service procedure for checking or cleaning the filter. If the filter is suspected of being plugged or restricted, it must be replaced.

3q. Cause of Low Line Pressure

1. Low Transmission Oil Level
2. Modulator Assembly - See Fig. 7-5.
3. Filter

A. Blocked or restricted.*

B. "O" Ring on intake pipe and/or grommet omitted or damaged.

C. Split or leaking intake pipe.

D. Wrong filter assembly.

4. Pump

A. Pressure regulator or boost valve stuck.

B. Gear clearance, damaged worn. (Pump will become damaged if drive gear is installed backwards, or if converter pilot does not enter crankshaft freely).

C. Pressure regulator spring, too weak.

D. Not enough spacers in pressure regulator.

E. Pump to case gasket mispositioned.

F. Defective pump body and/or cover.

G. Mismatch pump cover/pump body.

5. Internal Circuit Leaks

A. Forward clutch leak (pressure normal in neutral and reverse-pressure low in drive).

1. Check pump rings.
2. Check forward clutch seals.

B. Direct clutch leak (pressure normal in neutral, low, intermediate, and drive--pressure low in reverse).

1. Check center support oil seal rings.
2. Check direct clutch outer seal for damage.
3. Check rear servo and front accumulator pistons and rings for damage or missing.

6. Case Assembly

A. Porosity in intake bore area.

B. Check case for intermediate clutch plug leak or blown out.

C. Lo-reverse check ball mispositioned or missing (this will cause no reverse and no overrun braking in Lo range).

*There is no approved service procedure for checking or cleaning the filter, if the filter is suspected of being plugged or restricted. It must be replaced.

3r. Causes of High Line Pressure

1. Vacuum Leak
A. Full leak (vacuum line disconnected.)
B. Partial leak in line from engine modulator.
C. Improper engine vacuum.
D. Vacuum operated accessory leak. (Hoses, vacuum advance, etc.).
2. Damaged Modulator
A. Stuck valve.
B. Water in modulator.
C. Not operating properly - Part w.
3. Detent System
A. Detent switch actuated (plunger stuck) or shorted.
B. Detent wiring shorted.
C. Detent solenoid stuck open.
D. Detent feed orifice in spacer plate blocked.
E. Detent solenoid loose.
F. Detent valve bore plug damaged.
G. Detent regulator valve pin short.
4. Pump
A. Pressure regulator and/or boost valve stuck.
B. Incorrect pressure regulator spring.
C. Too many pressure regulator valve spacers.
D. Pump casting bad.
E. Pressure boost valve installed backwards or defective.
F. Aluminum bore plug has hole or otherwise defective.
G. Pressure boost bushing broken or otherwise defective.
5. Control Valve Assembly
A. Spacer plate-to-case gasket off location.
B. Wrong spacer plate-to-case gasket.

3s. Causes of Improper Vacuum at Modulator

1. Engine
A. Requires tune up.
B. Loose vacuum fittings.
C. Vacuum operated accessory leak (hoses, vacuum advance, etc.)
2. Vacuum Line to Modulator
A. Leak.
B. Loose fitting.
C. Restricted orifice, or incorrect orifice size.
D. Carbon build up at modulator vacuum fitting.
E. Pinched line.
F. Grease or varnish material in pipe (no or delayed upshift-cold).

3t. Causes of Oil Leaks

1. Transmission Oil Pan Leaks
A. Attaching bolts not correctly torqued.
B. Improperly installed or damaged pan gasket.
C. Oil pan gasket mounting face not flat.
2. Case Extension Leak
A. Attaching bolts not correctly torqued.
B. Rear seal assembly--damaged or improperly installed. (Propeller shaft yoke damaged)
C. Gasket--(Extension to case) damaged or improperly installed.
D. Porous casting.
E. Output shaft "O" ring damaged.
3. Case Leak
A. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine--"Loading" one side of the "O" ring.
B. Modulator assembly "O" ring seal--damaged or improperly installed.
C. Connector "O" ring seal--damaged or improperly installed.
D. Governor cover, gasket and bolts--damaged, loose; case face leak.
E. Damaged or porosity. Leak at speedometer driven gear housing or seal. Leak at speedometer hole plug.
F. Manual shaft seal--damaged, improperly installed.
G. Line pressure tap plug--stripped, shy sealer compound.
H. Vent pipe (refer to Item 5).
I. Porous case, or cracked at pressure plug boss.
4. Front End Leak
A. Front seal--damaged (check converter neck for nicks, etc., also for pump bushing moved forward) garter spring missing.
B. Pump attaching bolts, and seals--damaged, missing, bolts loose.
C. Converter--leak in weld.
D. Pump "O" ring seal--damaged. (Also check pump oil ring groove and case bore).
E. Porous casting (pump or case).
F. Pump--drain back hole not open.
5. Oil Comes Out Vent Pipe
A. Transmission over-filled.
B. Water in oil.
C. Filter "O" ring damaged or improperly assembled causing oil to foam.
D. Foreign material between pump and case or between pump cover and body.
E. Case--porous, pump face improperly machined.
F. Pump--shy of stock, porous.
G. Pump to case gasket mispositioned.
H. Pump breather hole blocked or missing.
I. Hole in intake pipe.
6. Oil Cooler Lines
A. Connections at radiator loose or stripped.
B. Connections at case loose or stripped.
7. Modulator Assembly
A. Diaphragm defective - Part w.

3u. Control Valve Assembly—Governor Line Pressure Check

1. Install line pressure gage.
2. Disconnect vacuum line to modulator.
3. With car on hoist (rear wheels off ground), foot off brake, in drive, check line pressure at 1000 RPM.
4. Slowly increase engine RPM to 3000 RPM and determine if a line drop occurs (7 psi or more).
5. If pressure drop occurs, disassemble, clean and inspect control valve assembly.
6. If no pressure drop occurs:
A. Inspect governor.
1. Stuck valve.
2. Weight freeness.
3. Restricted orifice in governor valve.

B. Governor feed system.

1. Check screen in governor feed pipe hole in case assembly.

2. Check for restrictions in governor pipe.

3v. Causes of Burned Clutch Plates

(NOTE: Burned clutch plates can be caused by incorrect usage of clutch plates. Also, anti-freeze in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.)

1. Forward Clutch

A. Check ball in clutch housing damaged, stuck or missing.

B. Clutch piston cracked, seals damaged or missing.

C. Low line pressure.

D. Manual valve mispositioned.

E. Restricted oil feed to forward clutch (Examples: Clutch housing to inner and outer areas not drilled, restricted or porosity in pump).

F. Pump cover oil seal rings missing, broken or undersize; ring groove oversize.

G. Case valve body face not flat or porosity between channels.

H. Manual valve bent and center land not ground properly.

2. Intermediate Clutch

A. Rear accumulator piston oil ring, damaged or missing.

B. 1-2 accumulator valve stuck in control valve assembly.

C. Intermediate clutch piston seals damaged or misssing.

D. Center support bolt loose.

E. Low line pressure (See Part q).

F. Intermediate clutch plug in case missing.

G. Case valve body face not flat or porosity between channels.

H. Manual valve bent and center land not ground properly.

3. Direct Clutch

A. Restricted orifice in vacuum line to modulator (poor vacuum response.)

B. Check ball in direct clutch piston damaged, stuck or missing.

C. Defective modulator bellows - Part w.

D. Center support bolt loose. (Bolt may be tight in support but not holding support tight to case).

E. Center support oil rings or grooves damaged or missing.

F. Clutch piston seals damaged or missing.

G. Front and rear servo pistons and seals damaged.

H. Manual valve bent and center land not cleaned up.

I. Case valve body face not flat or porosity between channels.

J. Intermediate roller clutch installed backwards.

K. 3-2 valve, 3-2 spring or 3-2 spacer pin installed in wrong location in 3-2 valve bore.

(NOTE: If direct clutch plates and front band are burned, check manual linkage. See Note 4.)

3w. Vacuum Modulator Assembly

The following procedure is recommended for checking Turbo Hydra-matic modulator assemblies in the field before replacement is accomplished.

1. Vacuum Diaphragm Leak Check. Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil. If oil is found, replace the modulator.

CAUTION: Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, the modulator should not be changed.

2. Atmospheric Leak Check. Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam, and the threaded screw seal, Fig. 7-26. Using a short piece of rubber tubing, apply air pressure to the vacuum pipe by blowing into the tube and observe for leak bubbles. If bubbles appear, replace the modulator.

(NOTE: Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.)

3. Bellows Comparison Check. Make a comparison gage, as shown in Fig. 7-27, and compare the load of a known good Hydra-matic modulator with the assembly in question.

a. Install the modulator that is known to be acceptable on either end of the gage.

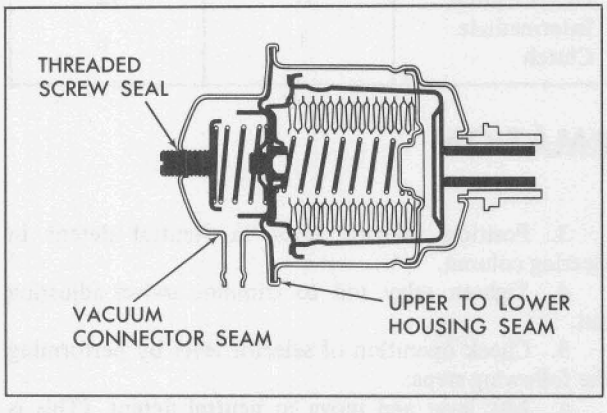


Fig. 7-26 Vacuum Modulator Cut Away View

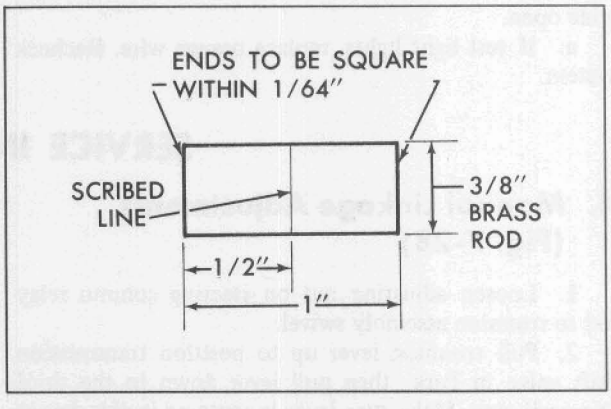


Fig. 7-27 Vacuum Modulator Test Gage

b. Install the modulator in question on the opposite end of the gage.

c. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gage. The gap between the opposite modulator sleeve end and the gage line should then be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

4. Sleeve Alignment Check. Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

Once the modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

3x. Downshift Solenoid Circuit Check

(NOTE: Before checking the downshift solenoid circuitry, make certain that the transmission downshift switch is properly adjusted as described in Note 5.)

1. With transmission shift lever in Park, turn ignition switch to "ON" position, but do not start car. Leave ignition switch "ON" throughout checking procedure.

2. Working under hood, slowly advance throttle linkage to wide open position. One click should be heard from transmission.

3. Allow throttle to return to closed position. One click should be heard from transmission.

4. If system performed as described above, downshift circuit is operating properly. If system does not perform as described above, proceed to step 5.

5. Use test light to check orange wire at connector on side of transmission case. Test light should light with throttle wide open and go out when throttle is released.

a. If system operates as described above, but did not perform properly during steps 1-3, replace solenoid after first checking to see that internal wiring is operational.

b. If light fails to light with throttle in wide open position, the circuit is open, proceed to step 6.

c. If light lights with throttle closed, the circuit is shorted. Proceed to step 9.

6. Remove air cleaner. Remove orange wire connector at transmission downshift switch. Use test light to check from the bare terminal at switch with throttle wide open.

a. If test light lights, replace orange wire. Recheck system.

b. If test light fails to light, proceed to step 7.

7. Check black striped orange feed wire at transmission downshift switch with test light.

a. If test light lights, replace transmission downshift switch. Recheck system.

b. If test light fails to light, proceed to step 8.

8. Check 10 amp (gages and transmission control fuse) in fuse panel.

a. If necessary to replace fuse, recheck system.

b. If fuse is all right, it will be necessary to locate the open in the wiring. Test the circuit continuity from the black-striped orange wire at the downshift switch to the battery.

9. Remove air cleaner. Remove orange wire connector at transmission downshift switch. Use test light to check from the bare terminal at switch with throttle closed.

a. If test light fails to light, orange wire is shorted. Correct shorting condition.

b. If test light lights, proceed to step 10.

10. With throttle in closed position, check black striped orange feed wire at transmission downshift switch.

a. If test light fails to light, replace transmission downshift switch. Recheck system.

b. If test light lights, it will be necessary to locate the short in the wiring. Test the circuit from the black-striped orange wire at the downshift switch to the battery.

3y. Type AA Clutch Parts

Clutch	No. of Flat Steel Clutch Plates	No. of Waved Steel Clutch Plates
Forward Clutch	*4	1
Direct Clutch	*5	1
Intermediate Clutch	2	1

*Steel Plate Thickness - .0915"

Clutch	No. of Clutch Composition Plates	No. of Piston Release Springs
Forward Clutch	5	16
Direct Clutch	6	14
Intermediate Clutch	3	6

SERVICE INFORMATION

4. Manual Linkage Adjustments (Fig. 7-28)

1. Loosen adjusting nut on steering column relay rod to trunnion assembly swivel.

2. Pull trunnion lever up to position transmission shift valve in Park, then pull lever down to the third (Neutral) step. Make sure lever is centered in this detent position.

3. Position selector lever in Neutral detent in steering column.

4. Tighten relay rod to trunnion swivel adjusting nut.

5. Check operation of selector lever by performing the following steps:

a. Lift lever and move to neutral detent. (This is the detent in the transmission.) Release the lever and

check to make sure that the lever fits into neutral detent in steering column.

b. Move lever to Drive detent. There should be a slight travel of the lever beyond this detent until the drive stop in the steering column is reached.

c. Move lever to Reverse detent and check as in b above.

WARNING: WHENEVER LINKAGE IS RE-ADJUSTED, CHECK FOR PROPER OPERATION OF NEUTRAL SWITCH, PARKING BRAKE RELEASE, BACK-UP LIGHTS AND COLUMN LOCK IN PARK. REFER TO SECTION 12, NOTE 41, FOR PROPER METHOD OF CHECKING FUNCTION OF NEUTRAL SWITCH.

5. Transmission Downshift Switch

a. Removal

1. Remove air cleaner.
2. Disconnect wire connectors.
3. Remove downshift switch.

(NOTE: Transmission downshift switch can be removed with anti-dieseling solenoid as an assembly by removing two screws at bracket under ignition coil mounts.)

b. Installation

(NOTE: If downshift switch was removed along with solenoid mounting bracket as an assembly, install bracket after positioning actuating shaft as described in step 1 and secure bracket under coil mount with two screws and washers.)

1. Hold switch in on-car position and rotate switch actuating shaft clockwise until it stops. Install lever on shaft with notch on inside and lever in straight-up position.
2. Insert shaft into hole on throttle adapter plate.
3. Insert two mounting screws through switch mounting to solenoid mounting bracket and lightly tighten.

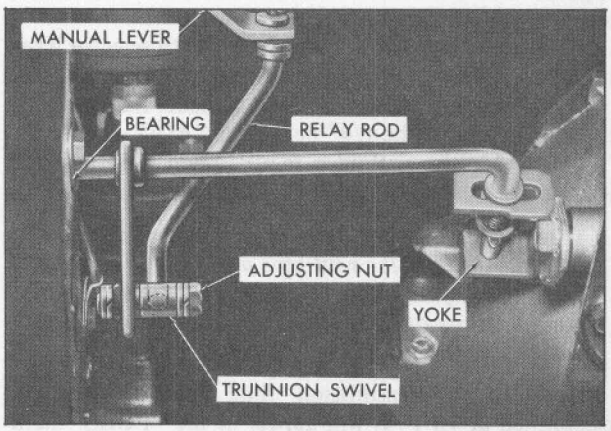


Fig. 7-28 Adjusting Manual Linkage

4. Adjust switch as described in Part c.
5. Connect wires to terminals on switch.
6. Replace air cleaner.

c. Adjustment

1. Remove carburetor air cleaner.
2. Make certain that carburetor is adjusted to specification and that throttle linkage is at low speed idle setting.
3. Loosen two mounting screws and insert a #42 (.094") wire gage size drill into the calibrating hole below lower wire terminal, Fig. 7-29. Adjust position of switch so that lever just touches the carburetor adapter plate arm (stud on 693).

With this adjustment the downshift switch should make contact above 60° throttle.

4. With switch positioned, tighten mounting screws and remove #42 (.094") gage from calibrating hold through switch.
5. Repeat step 3, if necessary.
6. Install air cleaner.

6. Checking and Adding Oil

(NOTE: Car level and oil temperature are particularly important when checking fluid level on a Turbo Hydra-matic transmission. Careful attention to the following procedures is necessary in order to determine the actual fluid level.)

a. Turbo Hydra-Matic Oil Recommendations

Whenever fluid is added, use only DEXRON® type transmission fluid, or fluids of equivalent quality that have been especially formulated and tested for use in the Turbo Hydra-matic transmission.

The transmission dipstick and filler tube on 1972 Cadillacs is located under the hood at the right rear top of the engine.

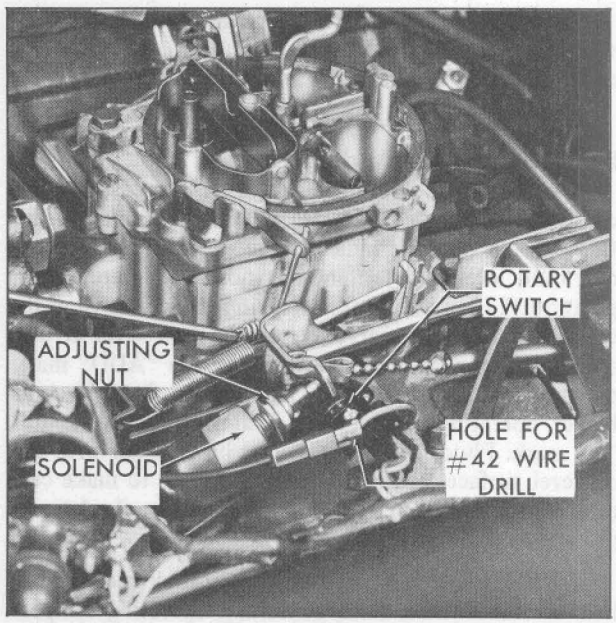


Fig. 7-29 Downshift Switch Adjustment

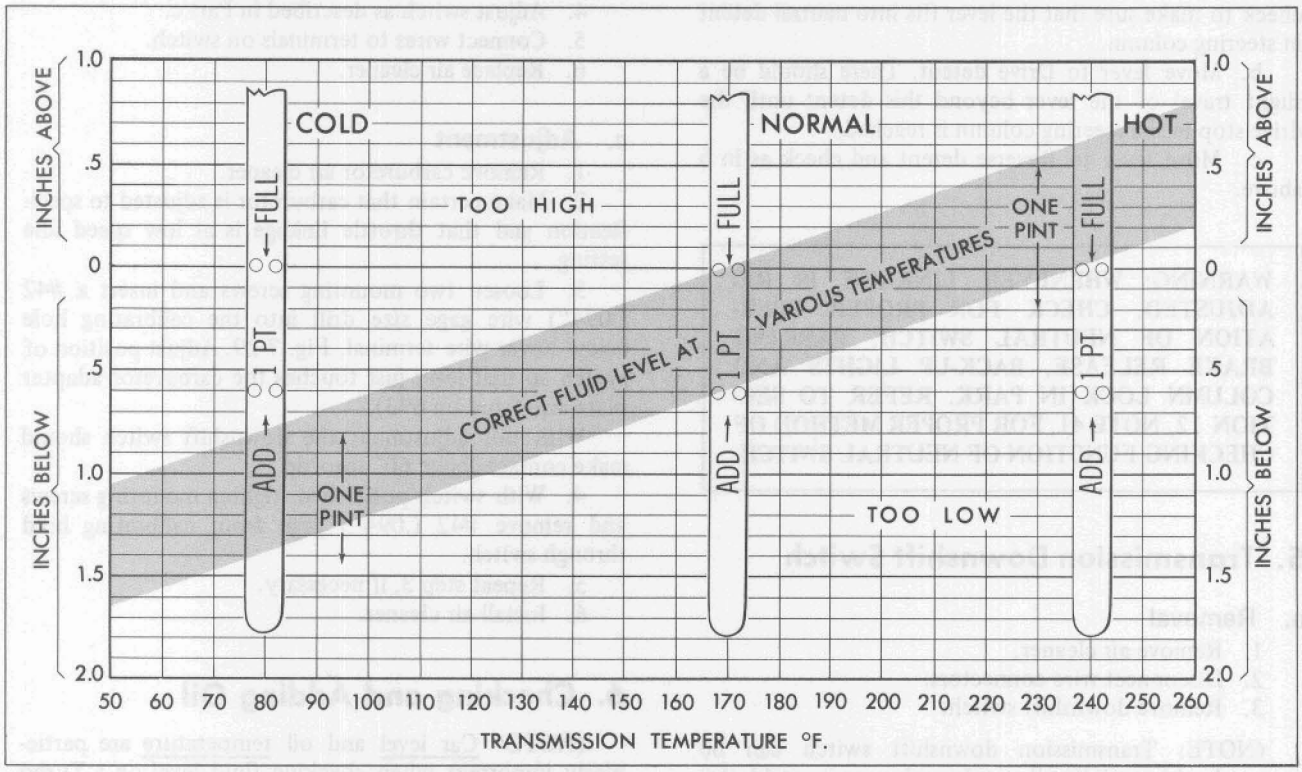


Fig. 7-30 Transmission Oil Level (Except 693)

The bottom pan should be drained every 24,000 miles and fresh fluid added to obtain the proper level on the dipstick, Fig. 7-30. For cars subjected to heavy city traffic during hot weather, or in commercial use, when the engine is regularly idled for prolonged periods, the bottom pan should be drained every 12,000 miles.

The oil intake system incorporates an intake pipe O-ring seal and filter assembly that should also be replaced after the first 24,000 miles.

In any case of a major transmission failure, the filter assembly must be replaced. In addition, the oil cooler and cooler lines should be flushed.

b. Checking and Adding Fluid

Fluid level should be checked at every engine oil change. The full "F" and "ADD" dimple marks on the transmission dipstick indicate one pint difference. Correct fluid level is determined at normal operating temperature (170°F.). Careful attention to transmission oil temperature is necessary, as proper fluid level at low operating temperatures will be below the "ADD" mark on the dipstick, Fig. 7-30, and proper fluid level at higher operating temperatures will rise above the full "F" mark. Fluid level must always be checked with car on level surface, and with engine running to make certain converter is full. To determine proper fluid level, proceed as follows:

(NOTE: The full mark on the dipstick is an indication of transmission fluid at normal operating temperature of 170°. This temperature is only obtained after several miles of stop-and-go driving.)

1. With manual control lever in Park position start engine. DO NOT RACE ENGINE. Move manual control lever through each range.
2. Immediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be at the "FULL" mark.

3. If additional fluid is required, add fluid to the "FULL" mark on the dipstick.

If vehicle is not driven 15 expressway miles or equivalent, and it becomes necessary to check fluid level, the transmission fluid must be at room temperature (70°F.).

With fluid at room temperature (70°F.) follow steps 1, 2 and 3 below.

1. With manual control lever in Park position start engine. DO NOT RACE ENGINE. Move manual control lever through each range.
2. Immediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be 1/4" below the "ADD" mark.

3. If additional fluid is required add fluid to bring level to 1/4" below the "ADD" mark on the dipstick.

CAUTION: Do not overfill, as foaming and loss of fluid through the vent pipe might occur as fluid heats up. If fluid is too low, especially when cold, complete loss of drive may result which can cause transmission failure.

(NOTE: If transmission fluid level is correctly established at 70°F. it will appear at the "FULL" mark on the dipstick when the transmission reaches normal operating temperature (170°F.). The fluid level is set

1/4" below the "ADD" mark on the dipstick to allow for expansion of the fluid which occurs as transmission temperatures rise to normal operating temperature of 170°F.)

c. Draining Bottom Pan and Replacing Intake Pipe and Filter Assembly

To drain bottom pan only, eliminate steps 5, 6 and 7.

1. Remove dipstick from filler tube and insert a length of hose secured to a suction gun down the filler tube. Remove 2 quarts of transmission fluid so that bottom pan will not overflow when removed.
2. Raise car on hoist or place on jack stands and provide container to collect draining oil.
3. Remove bottom pan and gasket. Discard gasket.
4. Drain fluid from bottom pan. Clean pan with solvent and dry thoroughly with clean compressed air.
5. Remove filter retainer bolt.
6. Remove intake pipe and filter assembly. Remove and discard intake pipe O-ring and filter.
7. Install new intake pipe O-ring onto pipe and install intake pipe into filter assembly.
8. Install intake pipe and filter assembly into case bore.
9. Install filter retainer bolt.
10. Install new gasket on bottom pan and install bottom pan. Tighten bottom pan attaching screws to 12 foot-pounds.
11. Lower car and add 4 quarts of transmission fluid through filler tube when replacing intake pipe O-ring seal and filter assembly. When draining bottom pan only add 2 quarts of transmission fluid.
12. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.
13. Reduce engine speed to slow idle and check fluid level. Add fluid, if necessary, to bring to proper level, Fig. 7-30.

d. Adding Fluid to Fill Dry Transmission and Converter Assembly

The fluid capacity of the Turbo Hydra-matic transmission and converter assembly is approximately 25 pints but correct level is determined by mark on dipstick rather than by amount added. It is important that proper level be maintained. In cases of transmission overhaul, when a complete fill is required, including converter, proceed as follows:

1. Add 8 quarts of transmission fluid through filler tube.
2. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.
3. Reduce engine speed to slow idle.
4. Check fluid level and add additional fluid, if necessary, to bring to proper level, Fig. 7-30.

7. Towing Instructions

Refer to Page 0-4 for towing instructions pertaining to 1972 Cadillac "C" cars.

8. Units That Can Be Removed With Transmission in Car

The following units can be removed from the transmission without removing transmission from car.

While the detailed procedure for removing each of the units, other than the extension housing and oil seal, and pressure regulator valve, is not outlined separately, the procedures covered under the transmission disassembly and assembly notes will apply.

a. Extension Housing

Removal - Note 10a
Installation - Note 10b
Oil Seal Replacement - Note 9

b. Pressure Regulator Valve

Removal - Note 11a
Installation - Note 11b

c. Vacuum Modulator and Valve

Removal - Note 15a
Installation - Note 17j

d. Governor Assembly

Removal - Note 15b
Disassembly - Note 16f
Installation - Note 17k

e. Speedometer Driven Gear Assembly and Either Speed Controlled Switch or Trackmaster Speed Sensor Whichever is Applicable

Removal - Note 15c.
Disassembly - Note 16g
Installation - Not 17l

f. Intake Pipe and Filter Assembly and Bottom Pan

Removal - Note 15d
Installation - Note 17m or Note 6c

g. Control Valve Assembly, Governor Pipes, and Detent Spring and Roller Assembly

Removal - Note 15e
Disassembly - Note 16h
Installation - Note 17i

h. Rear Servo Assembly

Removal - Note 15f
Disassembly - Note 16i
Installation - Note 17h

i. Detent Solenoid, Solenoid Connector, Control Valve Spacer and Gaskets, Check Balls, and Front Servo Assembly

Removal - Note 15h
Front Servo Disassembly - Note 16j
Installation - Note 17g

j. Detent Lever, Manual Shaft, and Parking Linkage

Removal - Note 15l
Installation - Note 17e

9. Extension Housing Oil Seal Replacement (Transmission in Car)

1. Raise car on hoist or place on jack stands.

2. Remove propeller shaft assembly as described in Section 4, Note 26a or 27a.

3. Use hammer to drive screwdriver under lip of oil seal and pry seal out of housing, Fig. 7-31.

4. Install new extension housing oil seal.

(NOTE: To prevent damage to the seal and correctly install, follow the procedure below.)

a. Undercut the webbing of Oil Seal Installer, J-21359, by approximately 1/8 inch, Fig. 7-32.

(NOTE: Undercutting the webbing will not affect the tool's utility as a past model tool on either the extension housing or pump oil seal, but will give the needed clearance between the webbing and the extension housing oil seal.)

b. Apply non-hardening sealer to outside of new seal and install seal in extension housing using Oil Seal Installer, J-21359, Fig. 7-33.

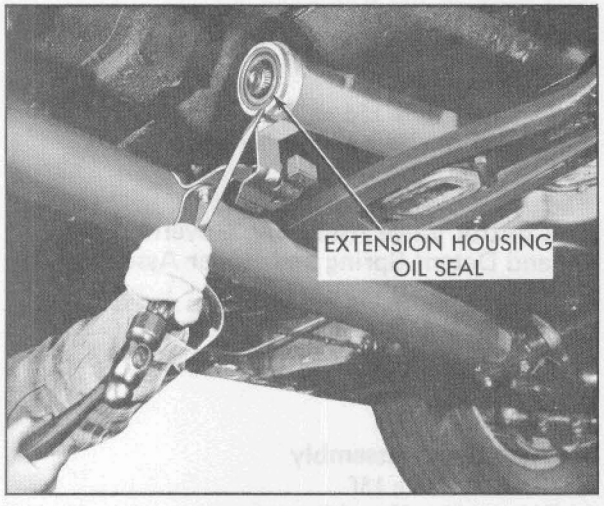


Fig. 7-31 Removing Extension Housing Oil Seal

5. Install propeller shaft assembly as described in Section 4, Note 26b or 27b.

6. Lower car.

10. Extension Housing Removal and Installation (Transmission in Car)

a. Removal

1. Raise car on hoist or place on jack stands.

2. Remove propeller shaft assembly as described in Section 4, Note 26a or 27a.

3. Remove rear engine mount to extension housing attaching screws.

4. Place jack under bottom oil pan. Use a block of wood to prevent damage to pan and raise transmission to lift extension housing off rear engine mount.

5. Remove six extension housing attaching screws and slide extension housing rearward and downward to remove from car. Make certain that output shaft splines do not come in contact with extension housing oil seal, as splines could damage seal lip.

6. Remove and discard O-ring from output shaft.

b. Installation

1. Install gasket on extension housing.

2. Install new O-ring on output shaft and grease O-ring and splines with specified lubricant.

3. Carefully install extension housing over output shaft and against transmission case. Do not permit output shaft to contact oil seal as splines could damage seal lip.

4. Install six extension housing to case attaching screws, tightening screws to 23 foot-pounds.

5. Lower transmission onto rear engine mount.

6. Install two rear engine mount to extension housing screws. Tighten screws to 55 foot-pounds.



Fig. 7-32 Altering Oil Seal Installer, J 21359



Fig. 7-33 Installing Extension Housing Oil Seal

7. Remove jack from bottom of oil pan.
8. Install propeller shaft assembly as described in Section 4, Note 26b or 27b.
9. Lower car.

11. Pressure Regulator Valve Removal and Installation (Transmission in Car)

a. Removal

CAUTION: The solid type pressure regulator valve does not contain oil holes and an orifice cup plug like the previous type pressure regulator valve. The solid style valve must only be used in the pump cover with the squared off pressure regulator boss, (pressure boost bushing end). See Fig. 7-35. The previous pressure regulator valve with the oil holes and orifice cup plug will be used to service either type pump cover.

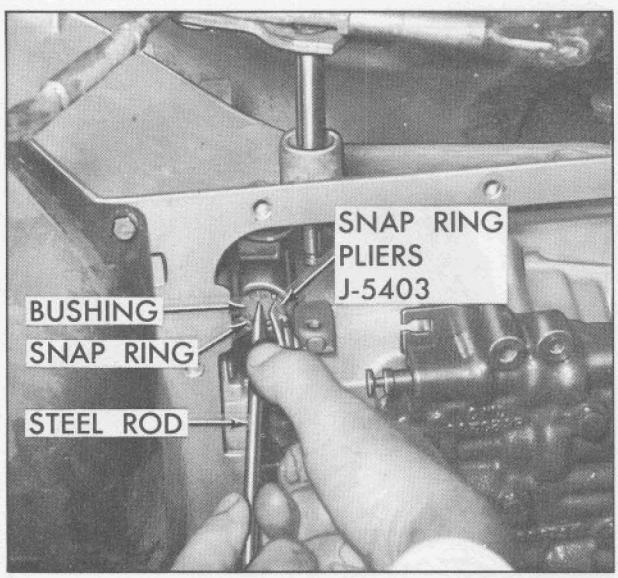


Fig. 7-34 Removing and Installing Pressure Regulator Valve

1. Raise car on hoist or place on jack stands. Provide container to catch oil.
2. Remove bottom pan and gasket. Drain oil.
3. Remove the filter retaining bolt and lift out pump intake pipe and filter assembly.
4. Remove and discard intake pipe O-ring and bottom pan gasket.
5. Using a screwdriver or steel rod, compress regulator boost valve bushing against pressure regulator spring, Fig. 7-34.

WARNING: PRESSURE REGULATOR SPRING IS UNDER EXTREME PRESSURE AND WILL FORCE VALVE BUSHING OUT OF BORE WHEN SNAP RING IS REMOVED IF VALVE BUSHING IS NOT HELD SECURELY.

6. Continue to exert pressure on valve bushing and remove snap ring, using Snap Ring Pliers, J-5403 (#21). Gradually release pressure on valve bushing until all spring force is exhausted.
7. Carefully remove regulator boost valve bushing and valve, and pressure regulator spring. Be careful not to drop parts, as they will fall out if they are not held.
8. Remove pressure regulator valve and spring retainer. Remove spacers if present. Be careful not to drop pressure regulator valve when removing it from bore.

b. Installation

1. Install spring retainer on pressure regulator spring. Also install spacers if previously removed.
2. Install pressure regulator valve on spring, stem end first.
3. Install boost valve into bushing, stem end out, and stack parts so that pressure regulator spring is against valve bushing.
4. Install complete assembly into pressure regulator valve bore, being careful not to drop parts during installation.
5. Using a screwdriver or steel rod, compress regulator boost valve bushing against pressure regulator spring

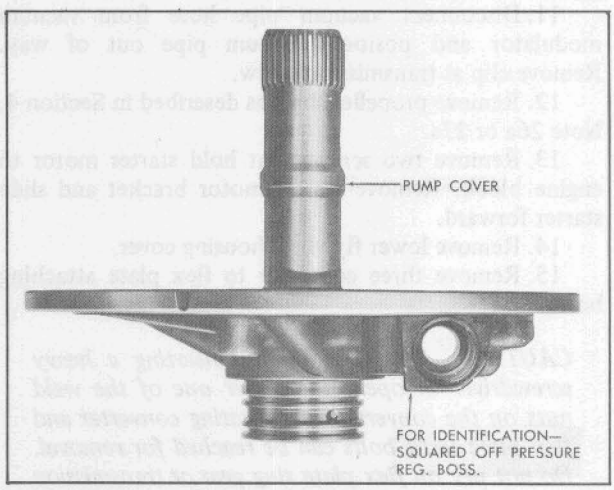


Fig. 7-35 Solid-Type Pressure Regulator Valve

until it is beyond snap ring groove, and install snap ring using Snap Ring Pliers, J-5403 (#21), Fig. 7-34.

(NOTE: To facilitate installation of snap ring, encircle it around screwdriver or steel rod, compress tangs with snap ring pliers, and slide snap ring upward into ring groove in valve bore.)

6. Install new intake pipe O-ring onto intake pipe and install intake pipe and filter assembly into transmission case bore, retaining filter with retainer bolt.
7. Install new gasket on bottom pan and install bottom pan.
8. Install thirteen bottom pan attaching screws. Tighten screws to 12 foot-pounds.
9. Lower car to floor and add fluid to transmission as required.

12. Transmission Removal and Installation

a. Removal

1. Disconnect negative battery cable.
2. Release parking brake.
3. Raise car on hoist or place on jack stands.
4. Disconnect rod from trunnion lever and wire relay rod up out of the way to prevent damage while removing transmission.
5. Remove two screws and bearing assembly from frame side rail.
6. Disconnect trunnion from manual yoke on left side of transmission.
7. Remove speedometer drive cable and disconnect electrical harness.
8. Remove upper right transmission case to engine attaching screw (filler tube bracket screw).
9. Remove filler tube from transmission case and plug hole in case.
10. Disconnect oil cooler pipes at transmission using an open end wrench or crowfoot adapter. Cap pipes and plug connector holes in transmission. Position oil cooler pipes out of way.
11. Disconnect vacuum pipe hose from vacuum modulator and position vacuum pipe out of way. Remove clip at transmission screw.
12. Remove propeller shaft as described in Section 4, Note 26a or 27a.
13. Remove two screws that hold starter motor to engine block. Remove starter motor bracket and slide starter forward.
14. Remove lower flywheel housing cover.
15. Remove three converter to flex plate attaching bolts.

CAUTION: This is done by inserting a heavy screwdriver in open slot under one of the weld nuts on the converter, and rotating converter and flex plate until bolts can be reached for removal. Do not pry on flex plate ring gear or transmission case to rotate converter, as flex plate or case might be damaged.

16. Place jack or other suitable device under rear of engine.
17. Remove parking brake equalizer nut and washer from cable stud and remove equalizer.
18. Remove retainer securing cable conduit at cross member and remove cable from bracket.
19. Remove wire guide from cross member.
20. Move cable around end of extension housing to top of transmission.
21. Position transmission jack under transmission and raise it just enough to take the load off rear engine support.
22. Remove two rear engine mount to extension housing screws.
23. Remove four bolts, two each side, from rear engine support and remove support.
24. Remove five remaining transmission case to engine attaching screws. It may be necessary to lower engine and transmission slightly to gain access to upper attaching screws.
25. Move transmission toward rear of car, disengaging transmission case from locating dowels on engine, install Converter Holding Clamp, J-21366, on front of transmission case, Fig. 7-36 and lower transmission from car.

CAUTION: Converter holding clamp must be used when removing transmission, otherwise converter can fall out when transmission is removed.

26. Remove Converter Holding Clamp from transmission case and remove converter from turbine shaft.

CAUTION: Converter with oil weighs approximately 50 pounds. Be careful not to drop or damage converter when removing it.

b. Installation

1. Install converter on turbine shaft making certain that converter drive hub is fully engaged with pump gear

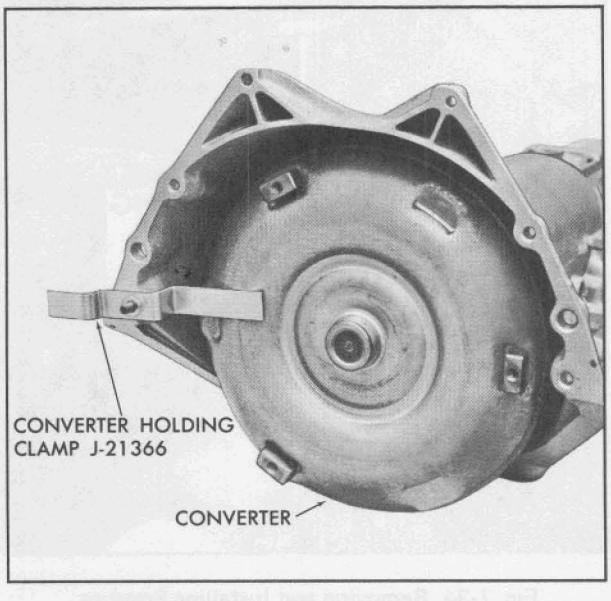


Fig. 7-36 Installing Converter Holding Clamp

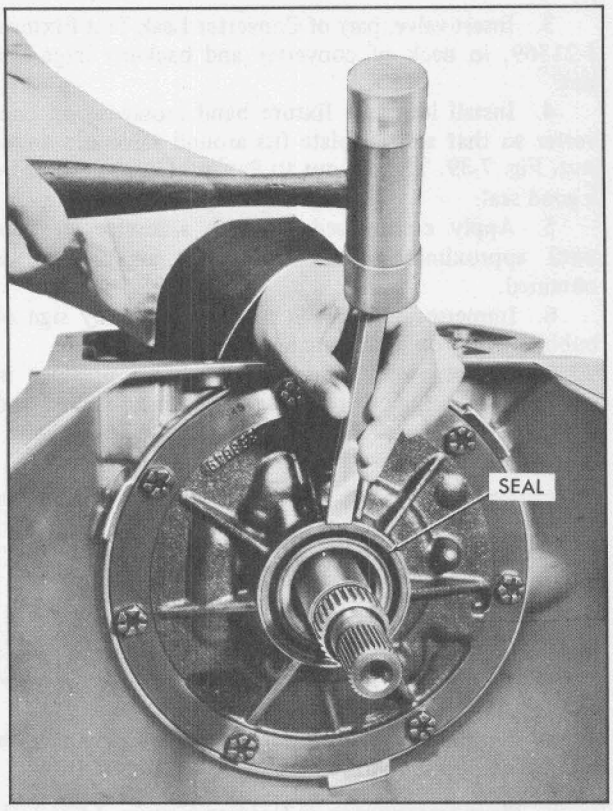


Fig. 7-37 Removing Pump Oil Seal

tangs, and install Converter Holding Clamp, J-21366, on front of transmission case, Fig. 7-36.

2. Place transmission on transmission jack and carefully raise into position. Remove Converter Holding Clamp.

3. Align front of transmission case with engine and dowel holes in transmission case with dowels on engine. Install five transmission case to engine attaching screws, tighten screws to 30 foot-pounds. Leave out filler tube bracket screw.

CAUTION: The procedure for attaching the converter to the flywheel as described in Steps 4 through 6 must be strictly followed. Any deviation from this procedure will result in improper installation and damage to flywheel and transmission.

4. Rotate converter until two of the three weld nuts on converter line up with two bolt holes in flywheel. Make certain converter rotates freely in this position and is not cocked and that pilot in center of converter is properly seated in crankshaft.

5. Install two flywheel to converter attaching bolts through accessible bolt holes in flywheel and tighten finger tight.

Bolts must not be tightened at this time to assure proper alignment of converter.

6. Insert screwdriver under converter weld nut, rotate converter and install third attaching bolt. Tighten all bolts to 28 foot-pounds.

7. Install lower flywheel housing cover screws tightening screws to 8 foot-pounds.

8. Position starter motor to engine block and install two screws, tightening screws to 30 foot-pounds.

9. Install starter motor brackets, tightening screws to 23 foot-pounds.

10. Raise engine and transmission to about one inch above normal height and install rear engine support on frame. Install two bolts on each side, tighten bolts to 30 foot-pounds.

11. Lower transmission carefully and install two rear engine mount to extension housing screws. Tighten screws to 55 foot-pounds.

12. Remove jacks.

13. Move parking brake cable around end of extension housing so cable hangs below transmission.

14. Install wire guide securing cable conduit at cross member.

15. Install cable conduit in bracket at cross member and secure with retainer.

16. Install cable in equalizer and secure to cable stud with nut and washer.

17. Check operation of parking brake and adjust if necessary as described in Section 5, Note 8.

18. Install speedometer cable and electrical harness to transmission.

19. Connect trunnion to manual yoke left side of transmission, placing small amount of Lubriplate in slotted leg of yoke.

20. Install grommet assembly to left frame rail.

21. Attach relay rod to trunnion lever.

22. Install vacuum hose on modulator, making sure modulator pipe is fully engaged with modulator.

23. Clean ends of oil cooler pipes with solvent and connect pipes to transmission using an open end wrench, or crowfoot adapter.

24. Unplug oil filler tube hole in transmission case. Using new O-ring on filler tube, install filler tube to case.

25. Install filler tube bracket and modulator clip under upper right transmission case to engine screw. Tighten screw to 30 foot-pounds torque.

26. Install screw in filler tube bracket on right exhaust manifold. Tighten screw to 60 foot-pounds.

27. Install propeller shaft as described in Section 4, Note 26b or 27b.

28. Check operation of manual linkage. Adjust, if necessary as described in Note 4.

29. Check brake pipes in area of cooler lines for possible damage.

30. Lower car and connect battery.

31. Add fluid to transmission as required.

13. Pump Oil Seal Replacement

1. Remove transmission assembly from car as described in Note 12a.

2. Use hammer to drive screwdriver or chisel under lip of oil seal and pry seal out of pump body, Fig. 7-37.

3. Before installing new seal, make certain bore is free from foreign material and that garter spring on seal is correctly positioned. Also check finish of converter neck and bearing surface in pump body.

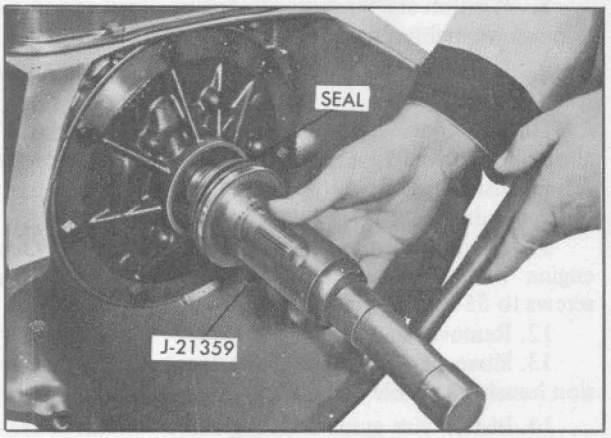


Fig. 7-38 Installing Pump Oil Seal

(NOTE: Use a non-hardening sealer on outside of seal body before installing seal.)

4. Install new seal in pump body using Pump Oil Seal Installer, J-21359, Fig. 7-38.

5. Install transmission assembly in car as described in Note 12b.

14. Converter

1. Remove transmission from car as described in Note 12a and remove converter from transmission.

2. Perform visual inspection as follows:

a. Inspect converter for visual signs of damage.

b. Inspect for wrong converter.

c. Inspect neck of converter for wear.

d. Inspect pump drive slots for signs of excessive wear.

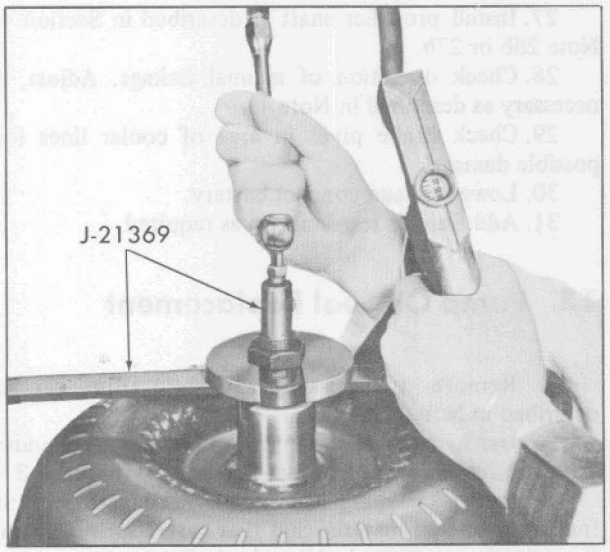


Fig. 7-39 Leak Checking Converter

3. Insert valve, part of Converter Leak Test Fixture, J-21369, in neck of converter and back-off large hex nut.

4. Install leak test fixture band crosswise on converter so that slotted plate fits around valve and under nut. Fig. 7-39. Tighten nut to expand O-ring and secure a good seal.

5. Apply compressed air with a service air hose until approximately 80 to 100 psi air pressure is obtained.

6. Immerse assembly in water, noting any sign of bubbles that would indicate a leak.

7. Depress valve stem to release air pressure in converter and then remove leak test fixture band and valve.

WARNING: ALWAYS RELEASE AIR PRESSURE BEFORE REMOVING VALVE, AS A DEFINITE HAZARD EXISTS SHOULD VALVE BLOW OUT DURING REMOVAL.

8. Thoroughly dry converter and install converter in transmission as follows:

a. Place transmission in Holding Fixture, J-8763-01 and install Holding Fixture in Holding Fixture Base, J-3289-20, so that transmission is positioned vertically with pump end up.

b. Carefully position converter on turbine shaft, making certain converter is properly aligned. Long screws or eyebolts can be threaded into the weld nuts on the converter and used as handles.

c. Rotate converter until the shafts are piloted and the converter lugs are indexed in the pump gear.

d. If difficulty is experienced in alignment, tap on outer diameter of converter with plastic-headed hammer, while turning converter.

9. Install transmission as described in Note 12b.

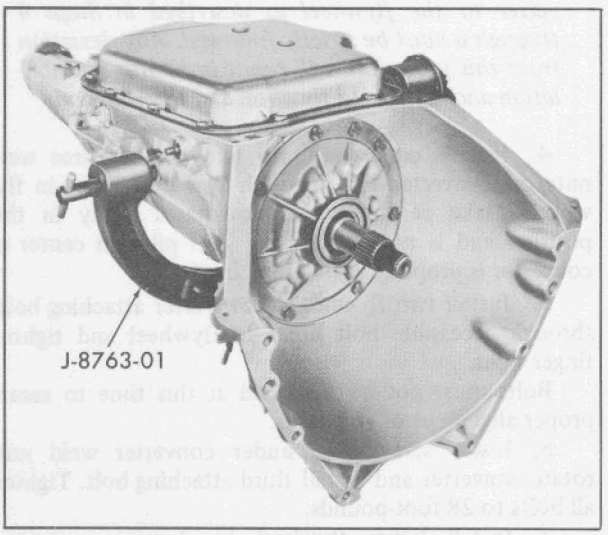


Fig. 7-40 Transmission in Holding Fixture

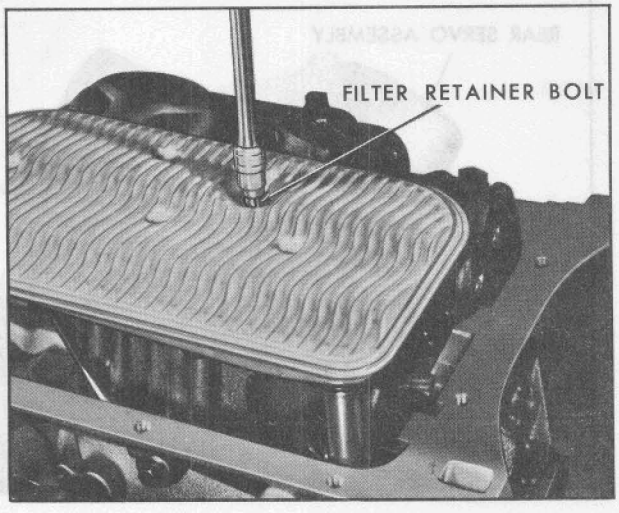


Fig. 7-41 Removing Filter Retaining Bolt

15. Major Transmission Components—Removal (Fig. 7-1)

15a. Remove Vacuum Modulator and Valve

(NOTE: Unit may be removed without removing transmission or bottom pan.)

1. Remove converter from transmission and install Holding Fixture, J-8763-01, on transmission so that vacuum modulator will be located on side of Holding Fixture nearest the bench. Install fixture and transmission into Holding Fixture Base, J-3289-20, with bottom pan facing up, Fig. 7-40, and install lock pin in base. Provide container to catch any oil that may drain from transmission.
2. Remove vacuum hose from modulator.
3. Remove vacuum modulator attaching screw and retainer from transmission case.
4. Remove modulator assembly and O-ring from case. Discard O-ring.
5. Remove modulator valve from transmission case.

15b. Remove Governor Assembly

(NOTE: Unit may be removed without removing transmission or bottom pan.)

1. Remove four attaching screws, governor cover, and gasket. Discard gasket.
2. Remove two bolts attaching transmission extension housing to cross member.
3. Move rear of transmission sideways enough to allow clearance for governor removal.
4. Remove governor assembly.

15c. Remove Speedometer Driven Gear Assembly and Either Speed Controlled Switch or Trackmaster Speed Sensor Whichever is Applicable

(NOTE: Unit may be removed without removing transmission or bottom pan, after removing speedometer cable from driven gear assembly.)

1. Remove attaching screw and retainer from left side of case. Apply slight pressure to remove unit and speedometer driven gear.

15d. Remove Intake Pipe and Filter Assembly and Bottom Pan

(NOTE: Unit may be removed with transmission in car. In cases of transmission failure, filter must be replaced.)

1. Remove bottom pan attaching screws.
2. Remove bottom pan and gasket. Discard gasket. Drain oil from pan if transmission is in car.
3. Remove filter retainer bolt, Fig. 7-41.
4. Lift out pump intake pipe and filter assembly, Fig. 7-42.
5. Remove intake pipe from filter and discard filter.
6. Remove and discard intake pipe O-ring.

15e. Remove Control Valve Assembly, Governor Pipes, and Detent Spring and Roller Assembly

(NOTE: Units may be removed with transmission in car, after removing bottom pan.)

1. Remove attaching screw and remove detent spring and roller assembly.
2. Remove ten remaining control valve assembly attaching screws. Do not remove solenoid attaching screws at this time.
3. Remove control valve assembly with the two governor pipes attached, Fig. 7-43.

CAUTION: Do not allow manual valve to fall out of its bore in control valve assembly. If transmission is in car be careful not to drop front servo group which may drop out as control valve assembly is removed.

4. Remove governor screen assembly from end of governor feed pipe or governor feed pipe hole in case. Fig. 7-44. Clean screen in clean solvent and air dry.
5. Remove governor pipes from valve body. Governor pipes are interchangeable and need not be identified.

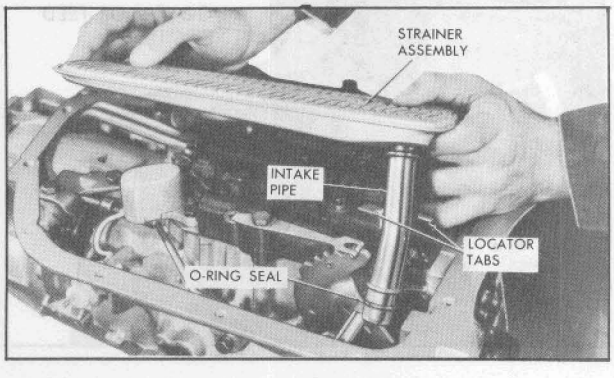


Fig. 7-42 Removing Intake Pipe and Filter Assembly

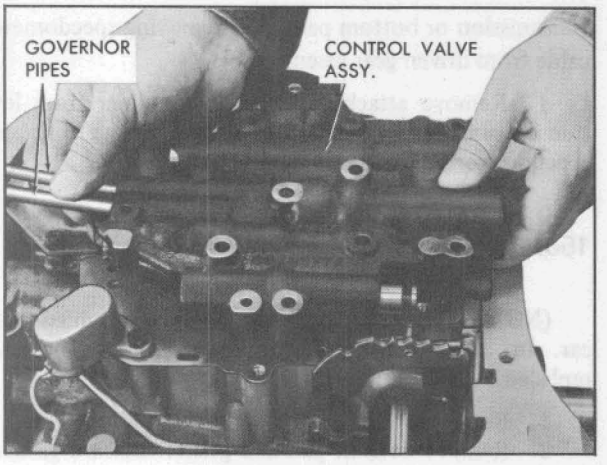


Fig. 7-43 Removing Control Valve Assembly

15f. Remove Rear Servo Assembly

(NOTE: Unit may be removed with transmission in car after removing bottom pan and allowing fluid to drain. Remove control valve assembly, and governor pipes (Note 15e.)

1. Remove six rear servo cover attaching screws, servo cover, and gasket. Discard gasket.
2. Remove rear servo assembly from transmission case, Fig. 7-45.
3. Remove servo accumulator spring.
4. Make band apply pin selection check to determine proper size pin to use at time rear servo is assembled. Proceed as follows:

15g. Band Apply Pin Selection Check

(NOTE: Check may be made with transmission in car. Remove bottom pan and allow fluid to drain. Remove control valve assembly, governor pipes Note 15e and rear servo Note 15f.)

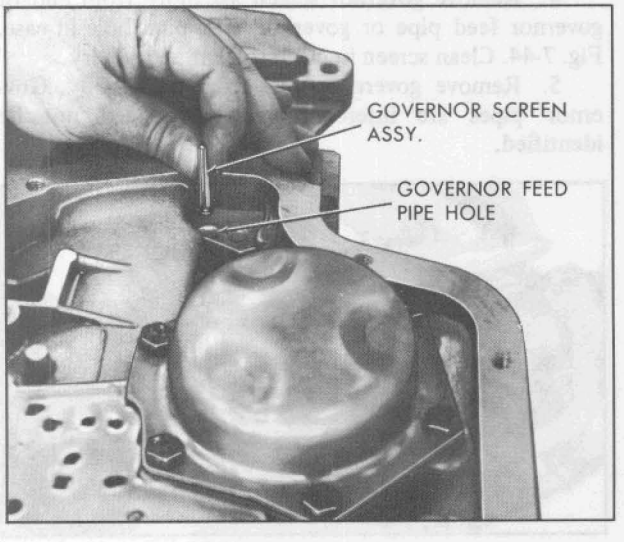


Fig. 7-44 Removing Governor Screen Assembly

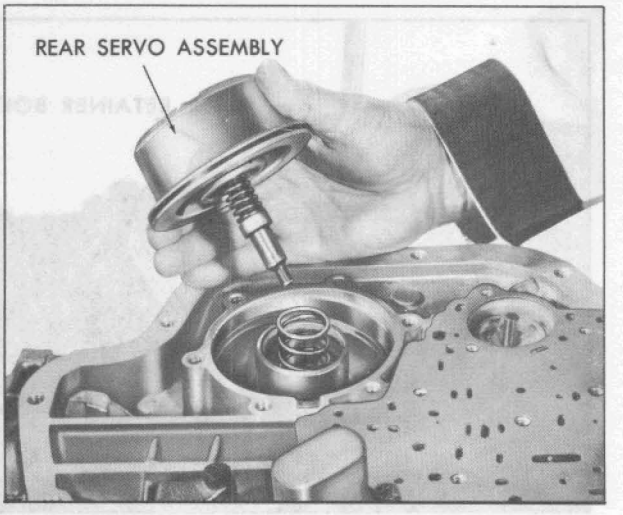


Fig. 7-45 Removing Rear Servo Assembly

1. Position Band Apply Pin Selector Gage, J-21370-6, on transmission case over rear servo bore, with hex nut on side of gage facing toward parking brake linkage, and smaller diameter end of Gage Pin, J-21370-5, in servo pin bore, Fig. 7-46.

2. Secure gage with two 5/16-18 x 1 inch screws, tightening screws to 18 foot-pounds. Make certain that stepped gage pin is free to move up and down in both tool and servo pin bore. Stepped side of pin must face front of transmission case.

Band apply pins are available in three sizes as shown in the following chart:

IDENTIFICATION	LENGTH
Three Rings	Long
Two Rings	Medium
One Ring	Short

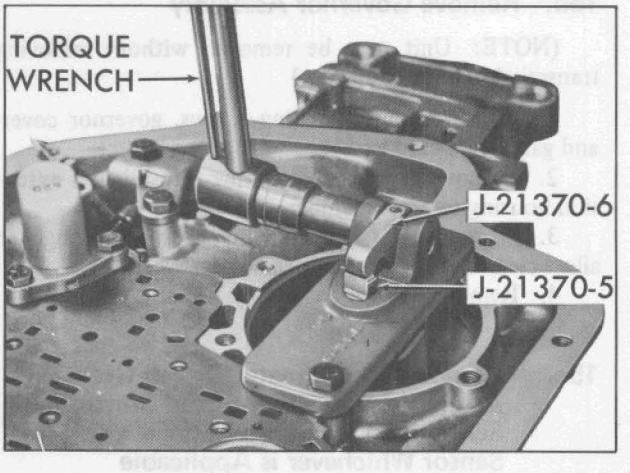


Fig. 7-46 Band Apply Pin Selection Check

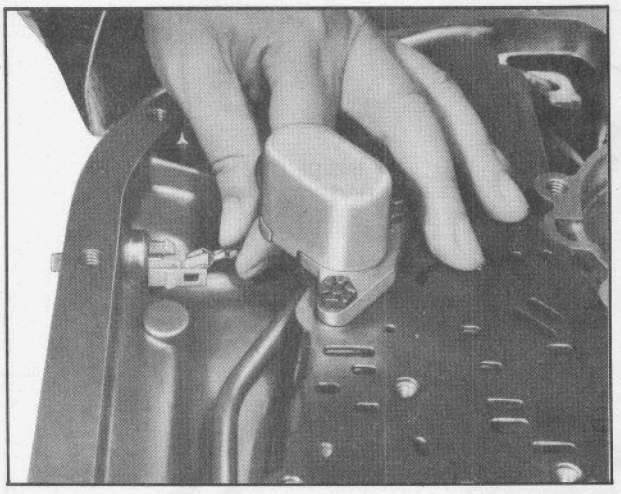


Fig. 7-47 Removing Wires from Electrical Connector

Identification ring is located on band lug end of pin. Selecting the proper pin is equivalent to adjusting band.

3. To determine proper size pin to use, apply 25 foot-pounds torque on hex nut on side of gage, Fig. 7-46. This will cause lever on top of gage to depress stepped gage pin into servo pin bore, simulating actual operating conditions. Note relation of steps on gage pin and machined surface on top of gage. Determine proper size pin as follows:

a. If machined surface on top of gage is even with or above upper step on gage pin, long size pin (three rings) is required.

b. If machined surface on top of gage is between upper and lower steps on gage pin, medium size pin (two rings) is required.

c. If machined surface on top of gage is even with or below step on gage pin, short size pin (one ring) is required.

4. If new pin is required, make note of pin size required, and remove gage from transmission case.

15h. Remove Downshift Solenoid, Solenoid Connector, Lead Wire Assembly, Control Valve Spacer, Gaskets, Check Balls, and Front Servo Assembly

(NOTE: Units may be removed with transmission in car. Remove bottom pan and drain transmission fluid).

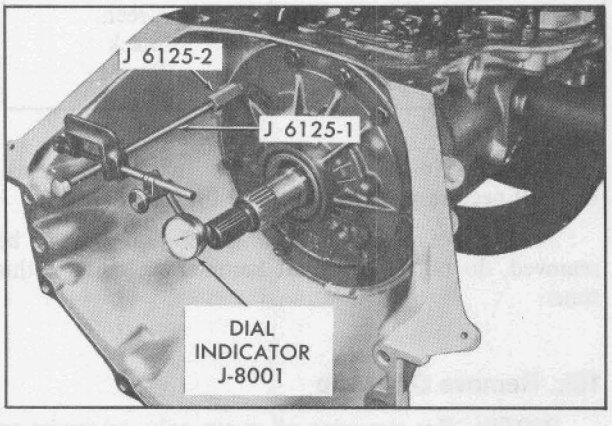


Fig. 7-48 Front Unit End Play Check



Fig. 7-49 Removing Pump Assembly

To remove control valve spacer, gasket, check balls, and front servo, remove control valve assembly and governor pipes Note 15e.

1. Disconnect downshift solenoid wire and lead wire from electrical connector terminal, see Fig. 7-47.

2. Compress tabs on case connector and remove connector and O-ring from case. Discard O-ring.

3. Remove two downshift solenoid attaching screws and remove solenoid assembly and gasket.

4. Remove control valve spacer plate from case.

(NOTE: If operation is being performed on car, lower control valve spacer plate in a level plane so that check balls don't fall out. Then remove check balls from spacer plate.)

5. Remove six check balls from cored passages in transmission case.

6. Lift front servo piston, retainer ring, pin, spring retainer, and spring out of transmission case.

15i. Remove Rear Oil Seal and Extension Housing

(NOTE: Units may be removed with transmission in car. See Notes 9 and 10.)

1. If required, use hammer to drive screwdriver under oil seal flange and pry seal out of extension housing.

2. Remove six extension housing attaching screws and remove extension housing.

3. Remove and discard gasket from extension housing.

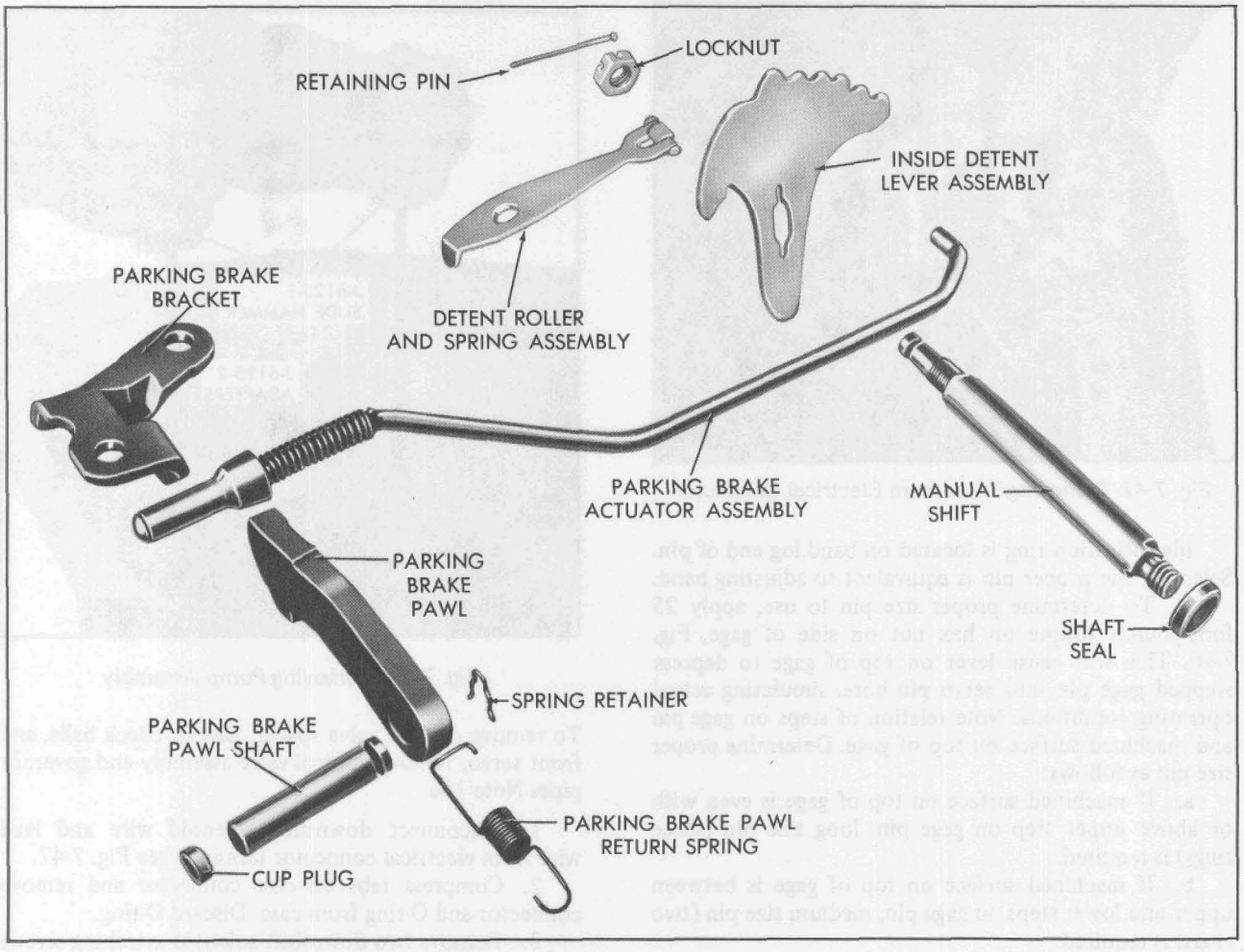


Fig. 7-50 Manual and Parking Linkage (Exploded View)

15j. Front Unit End Play Checking Procedure

(NOTE: Transmission must be removed from car Note 12a.)

1. Remove one oil pump attaching screw and rubber-coated washer at either 10 o'clock or 5 o'clock position.

2. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, in screw hole where attaching screw was removed.

3. Mount Dial Indicator, J-8001, on slide hammer bolt and index indicator to register with flat surface on end of turbine shaft.

4. Hold output shaft forward while pushing turbine shaft rearward to its stop.

5. Set dial indicator to zero.

6. Pull turbine shaft forward, Fig. 7-48.

Note resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .003 inch- .024 inch. The selective washer controlling this end play is the washer located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the following chart.

THICKNESS (INCH)	COLOR
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black
.126 - .130	Purple

(NOTE: An oil-soaked washer may tend to discolor. If necessary, measure washer for thickness.)

7. Remove dial indicator. If oil pump is to be removed, do not remove slide hammer assembly at this time.

15k. Remove Oil Pump

(NOTE: For removing oil pump only, transmission must be removed from car Note 12a.)

1. If not done previously, perform the following steps:

a. Remove one oil pump attaching screw and rubber-coated washer at either 10 o'clock or 5 o'clock position.

b. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, in screw hole where attaching screw was removed, Fig. 7-49.

2. Remove other pump attaching screws and washers.

3. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, into other threaded hole at 10 o'clock or 5 o'clock position in pump body and drive outward with slide hammers to remove pump assembly from transmission case, Fig. 7-49.

CAUTION: Drive outward in unison on both slide hammer assemblies to prevent cocking pump assembly in case.

4. Remove slide hammer assemblies from pump.

5. Remove and discard pump square cut O-ring and gasket.

15l. Remove Detent Lever, Manual Shaft, and Parking Linkage (Fig. 7-50)

(NOTE: Units may be removed with transmission in car. Drain transmission fluid by removing bottom pan. Remove manual linkage from manual lever and remove detent spring and roller assembly from control valve assembly.)

1. Remove pin securing manual shaft to case.

(NOTE: If procedure is being performed on car, bend pin to remove it.)

2. Loosen locknut securing inside detent lever to manual shaft.

3. Pry or work inside detent lever loose from manual shaft and remove locknut.

4. Remove manual shaft, parking actuator rod and detent lever from case.

(NOTE: Do not remove manual shaft seal unless replacement is required.)

5. Remove parking brake bracket attaching screws and remove bracket.

6. Remove parking pawl return spring.

(NOTE: The following steps are to be completed only if one or more of the parts involved require replacement.)

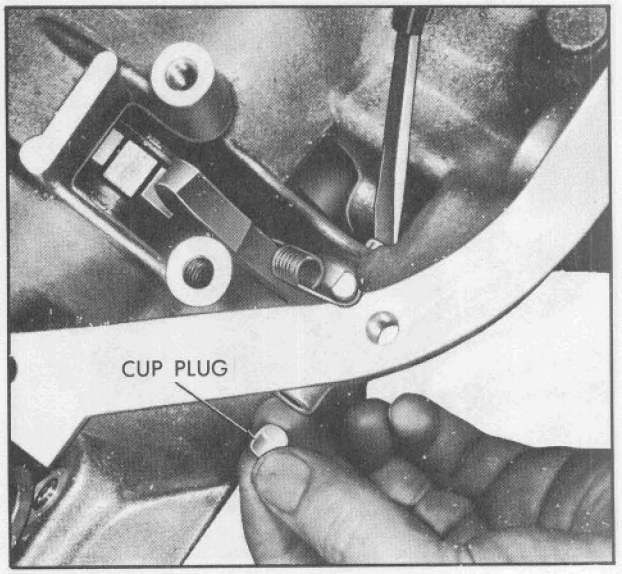


Fig. 7-51 Removing Cup Plug

7. Remove spring retainer from parking pawl shaft.

8. Remove parking brake pawl shaft cup plug by placing screwdriver between parking pawl shaft and case rib and prying outward, Fig. 7-51.

9. Remove parking pawl shaft and parking pawl.

15m. Remove Turbine Shaft, Forward Clutch Housing, Direct Clutch Assembly, Sun Gear Shaft, and Front Band

(NOTE: Transmission must be removed from car Note 12a. Required removal of oil pump Note 15k.

1. Remove turbine shaft and forward clutch assembly from transmission, Fig. 7-52.

2. Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with forward clutch assembly.

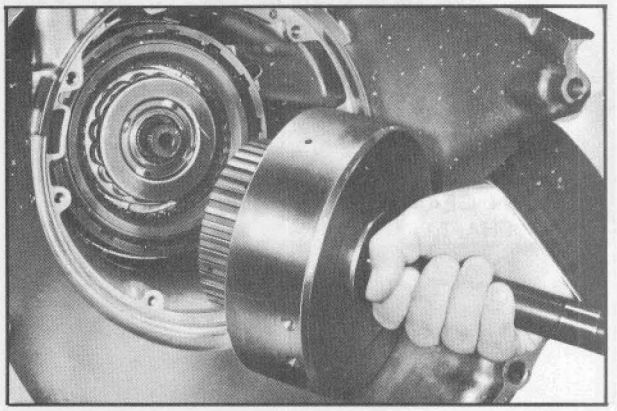


Fig. 7-52 Removing Forward Clutch Assembly

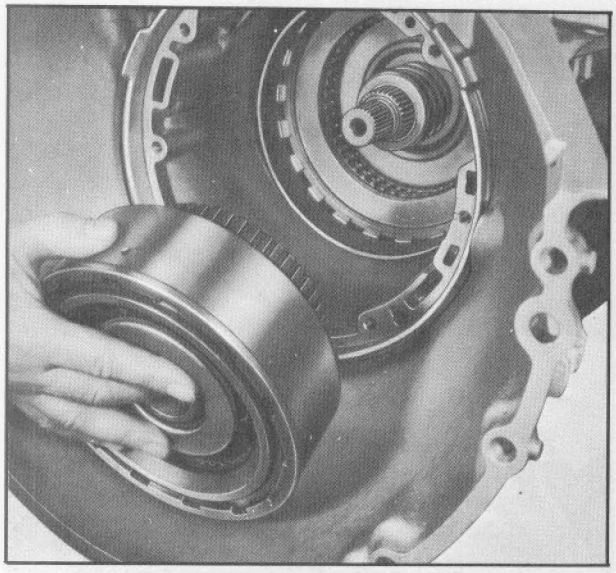


Fig. 7-53 Removing Direct Clutch and Intermediate Roller Assembly

3. Remove direct clutch and intermediate roller assembly, Fig. 7-53. Sun gear shaft may come out with direct clutch assembly.

4. Remove sun gear shaft if not previously removed. See Fig. 7-54.

5. Remove front band assembly.

(NOTE: Check rear unit end play at this time. Proceed as follows:)

15n. Rear Unit End Play Checking Procedure

(NOTE: Transmission must be removed from car Note 12a. Required removal of extension housing.)

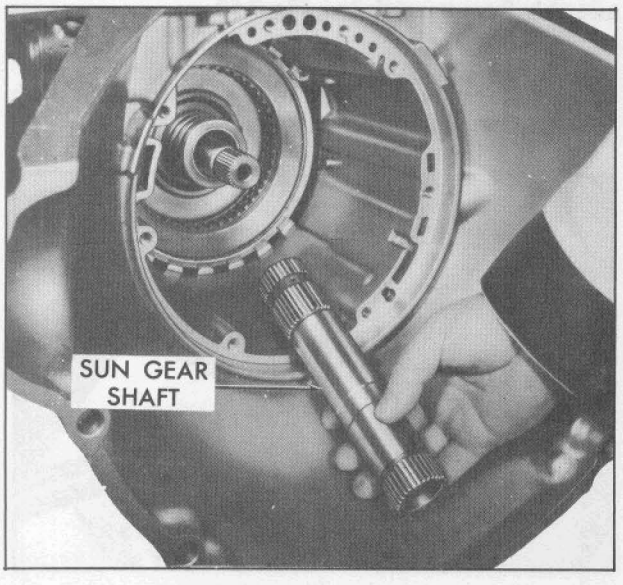


Fig. 7-54 Removing Sun Gear Shaft

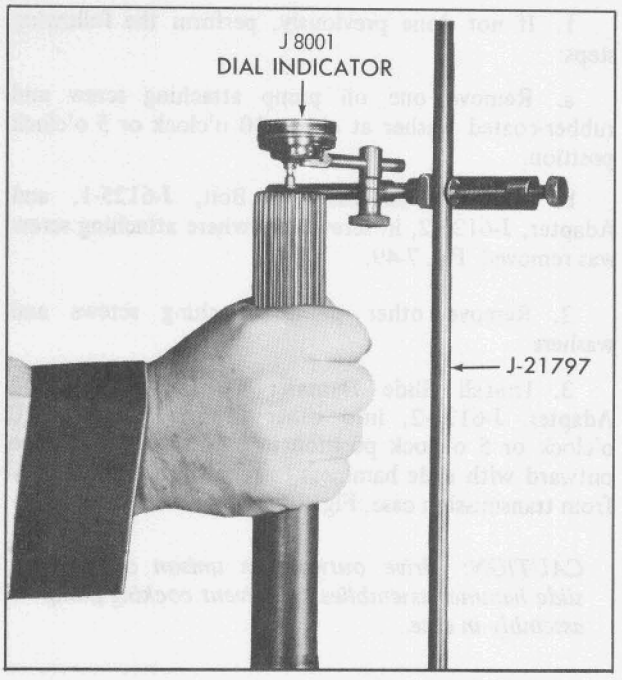


Fig. 7-55 Checking Rear Unit End Play

1. Install Speedometer Puller Bolt, J-21797, in one of the bolt holes on end of transmission case.

2. Mount Dial Indicator, J-8001, on Bolt, J-21797, and index indicator to register with flat surface on end of output shaft, Fig. 7-55.

3. Set dial indicator to zero.

4. Move output shaft in and out. Note resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .007 inch - .019 inch.

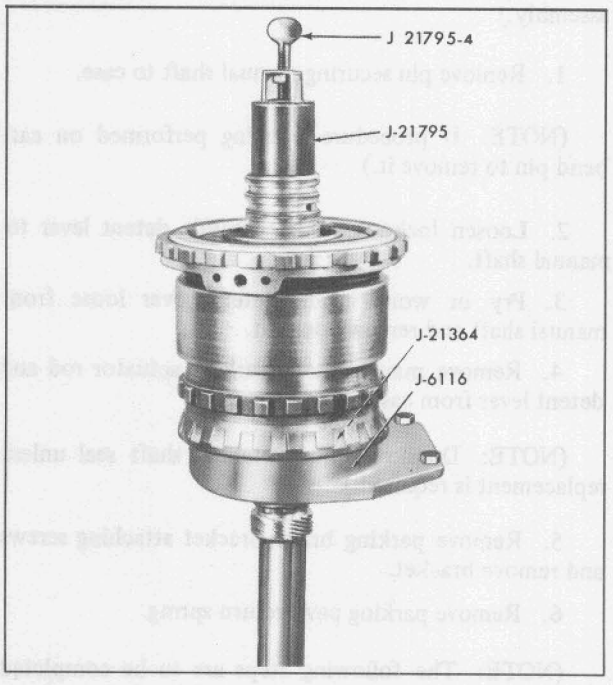


Fig. 7-56 Gear Unit in Holding Fixture

The selective washer controlling this end play is the steel washer with the three tabs, located between thrust washer and rear face of transmission case. Notches and/or numerals on the tabs serve to identify washer thickness.

If a different washer thickness is required to bring end play within specifications, it can be selected from the following chart. The tabs will show identification notches numerals or both.

THICKNESS (INCH)	IDENTIFICATION NOTCH AND/OR NUMERAL	
.074 - .078	None	1
.082 - .086	On Side of 1 Tab	2
.090 - .094	On Side of 2 Tabs	3
.098 - .102	On End of 1 Tab	4
.106 - .110	On End of 2 Tabs	5
	On End of 3 Tabs	6

15o. Remove Remaining Components

(NOTE: Transmission must be removed from car Note 12a. Requires removal of bottom pan, control valve assembly and governor pipes Note 15e, rear servo assembly Note 15f, control valve spacer, two gaskets, check balls and front servo assembly Note 15h, oil pump Note 15k, turbine shaft forward clutch housing, direct clutch assembly, sun gear shaft and front band Note 15m.)

1. Remove center support bolt from transmission case using 3/8 inch 12-point thin wall deep socket.



Fig. 7-57 Removing Center Support to Reaction Carrier Thrust Washer

2. Remove intermediate clutch backing plate to case snap ring.
3. Remove intermediate clutch backing plate, and three composition and three steel clutch plates.
4. Using needle nose pliers, or screwdriver, remove center support to case snap ring.
5. Install Tool, J-21795, on end of main shaft so that tangs engage groove in shaft. Tighten screw on tool to secure tool on shaft and prevent movement of roller clutch during removal of gear unit assembly, Fig. 7-56.
6. Install proper diameter length of pipe over output shaft to be used as a handle and to prevent spline damage to case bushing when removing gear unit, center support, and reaction carrier.

(NOTE: Loosen transmission holding fixture pivot pin slightly, so that gear unit assembly does not bind when it is removed from case.)

7. With transmission case in a horizontal position, shift complete assembly toward front of case to facilitate removal of assembly from case. Remove complete gear unit assembly from case.

CAUTION: Be careful not to drop or bump assembly in transmission case during removal. This could result in damage to output shaft bushing in case as well as to assembly itself.

8. Remove output shaft to case thrust washer from output shaft or case.
9. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116, place gear unit assembly in holding fixture with mainshaft pointing upward, Fig. 7-56. Remove Tool J-21795.
10. Remove rear unit selective washer from transmission case.
11. Remove the support to case spacer (refer to Fig. 7-198).
12. Remove rear band assembly. To facilitate removal, rotate band lugs away from pins and pull band assembly out of transmission case.
13. Remove center support assembly from reaction carrier by lifting straight upward.
14. Remove center support to reaction carrier thrust washer, Fig. 7-57.

(NOTE: Thrust washer may have stuck to back of center support. If so, remove from center support.)

15. Remove reaction carrier and roller clutch assembly from output carrier, Fig. 7-58, and remove roller clutch assembly from reaction carrier.

16. Transmission Disassembly, Cleaning, Inspection and Assembly of Individual Units

Inspect each part thoroughly after the transmission and individual units have been disassembled and cleaned, to determine which parts should be replaced. It is very

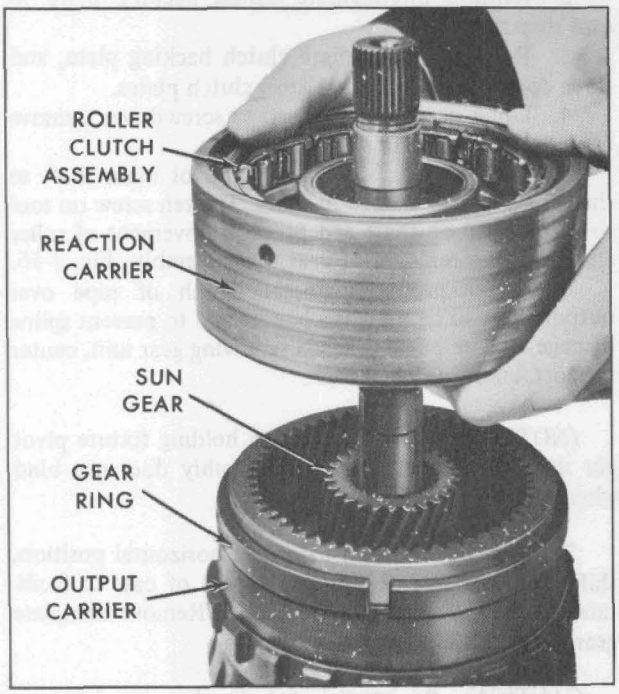


Fig. 7-58 Roller Clutch Assembly

important to distinguish between parts that are simply "worn-in" and those parts worn to the extent that they affect operation of the unit. Only "worn-out", broken or damaged parts should be replaced.

16a. Inspection of Torque Converter

1. Check converter for leaks as described in Note 14.
2. Check converter hub surfaces for signs of scoring or wear.

16b. Inspection of Vacuum Modulator and Valve

1. Inspect vacuum modulator for any signs of bending or distortion.
2. Inspect O-ring seat for damage.
3. Inspect modulator valve for nicks or damage.
4. Check freeness of valve operation in case bore.
5. Check modulator for damaged bellows. Modulator plunger is under approximately 16 pounds pressure. If bellows is damaged, plunger will have very little pressure. Use procedure outlined in Note 3w.

16c. Inspection of Extension Housing

1. Inspect bushing and rear seal for excessive wear or damage.
2. Inspect gasket mounting face for damage.
3. Inspect housing for cracks or porosity.
4. Be sure rear seal drain back port is not blocked.

16d. Inspection of Detent Lever, Manual Shaft, and Parking Linkage

1. Inspect parking actuator rod for cracks, or broken spring retainer lugs.
2. Inspect actuator spring for damage.
3. Inspect actuator for a free fit on actuator rod.
4. Inspect parking pawl for cracks or wear.
5. Inspect manual shaft for damaged threads.
6. Inspect inside detent lever for cracks or a loose pin.
7. Inspect parking pawl return spring for deformed coils or ends.
8. Inspect parking bracket for cracks or wear.
9. Inspect detent spring and roller assembly.

16e. Inspection of Transmission Case

1. Inspect case assembly for cracks, porosity or interconnected passages, Fig. 7-18 and 7-19.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. Inspect intermediate clutch driven plate lugs for damage or brinelling.
5. Inspect snap ring grooves for damage.
6. Inspect governor assembly bore for scratches or scoring.
7. Inspect modulator valve bore for scoring or damage.
8. Inspect cup plug inside case for good staking and sealing, Fig. 7-19;

CAUTION: If the case assembly requires replacement, make sure the center support to-case spacer is removed from the old case and reinstalled in the new case.

16f. Governor Assembly (Fig. 7-59)

All components of the governor assembly, with the exception of the driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble the governor assembly in order to replace the driven gear. Disassembly may also

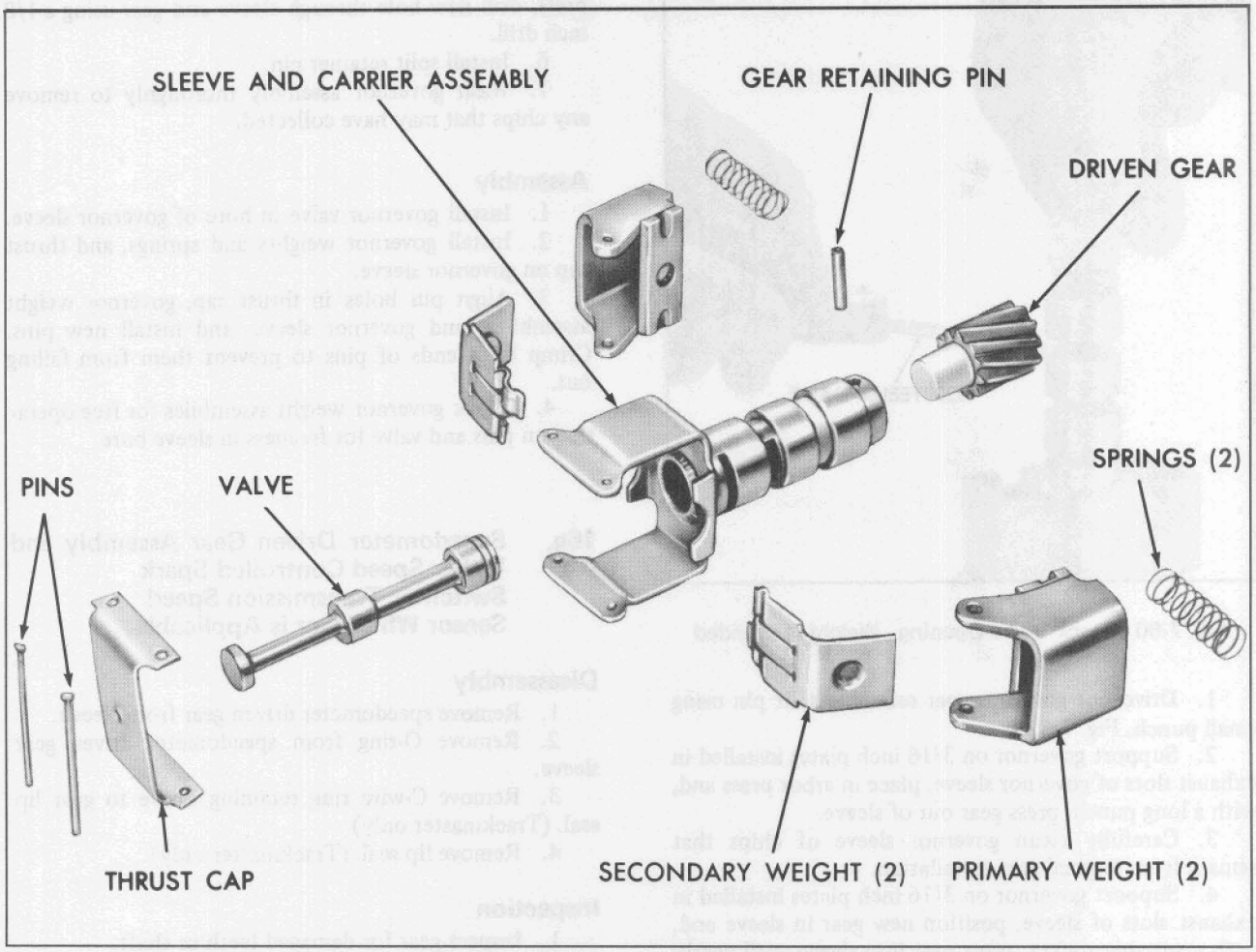


Fig. 7-59 Governor Assembly - Exploded View

be necessary due to foreign material causing improper operation. In such cases, proceed as follows:

Disassembly

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified.
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform the following inspections and replace governor driven gear if necessary.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring and galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor springs for distortion or damage.
9. Check governor weights for free operation in their retainers.
10. Check valve opening at entry (.020" minimum) with a feeler gage, holding governor as shown with governor weights extended completely outward, Fig. 7-60.
11. Check valve opening at exhaust (.020" minimum) with a feeler gage, holding governor as shown with governor weights completely inward, Fig. 7-61.

Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

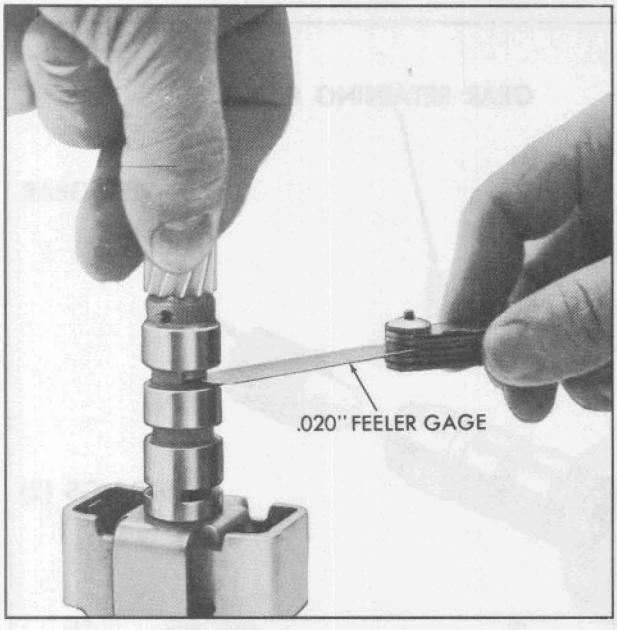


Fig. 7-60 Check Valve Opening - Weights Extended

1. Drive out governor gear retaining split pin using small punch, Fig. 7-62.
2. Support governor on 3/16 inch plates installed in exhaust slots of governor sleeve, place in arbor press and, with a long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 3/16 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90° from existing hole, center punch, and then while supporting governor in press, drill new hole through sleeve and gear using a 1/8 inch drill.
6. Install split retainer pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

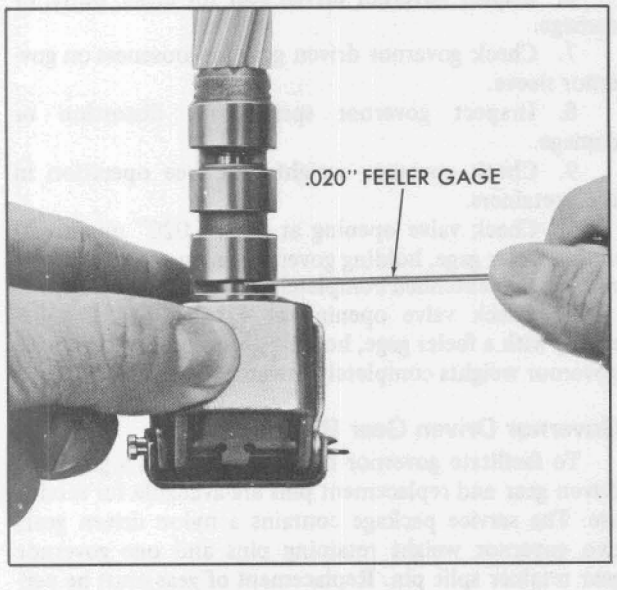


Fig. 7-61 Check Valve Opening - Weights Inward

Assembly

1. Install governor valve in bore of governor sleeve.
2. Install governor weights and springs, and thrust cap on governor sleeve.
3. Align pin holes in thrust cap, governor weight assemblies, and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.
4. Check governor weight assemblies for free operation on pins and valve for freeness in sleeve bore.

16g. Speedometer Driven Gear Assembly and Either Speed Controlled Spark Switch or Transmission Speed Sensor Whichever is Applicable.

Disassembly

1. Remove speedometer driven gear from sleeve.
2. Remove O-ring from speedometer driven gear sleeve.
3. Remove C-wire ring retaining sleeve to gear lip seal. (Trackmaster only)
4. Remove lip seal. (Trackmaster only)

Inspection

1. Inspect gear for damaged teeth or shaft.
2. Inspect sleeve for scores, damaged threads or cracks.
3. Inspect seals for cuts or damage.

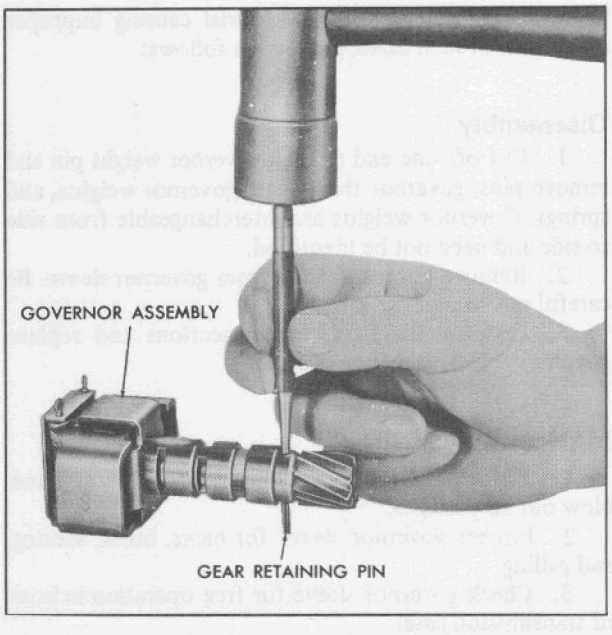


Fig. 7-62 Removing Governor Driven Gear Retaining Pin

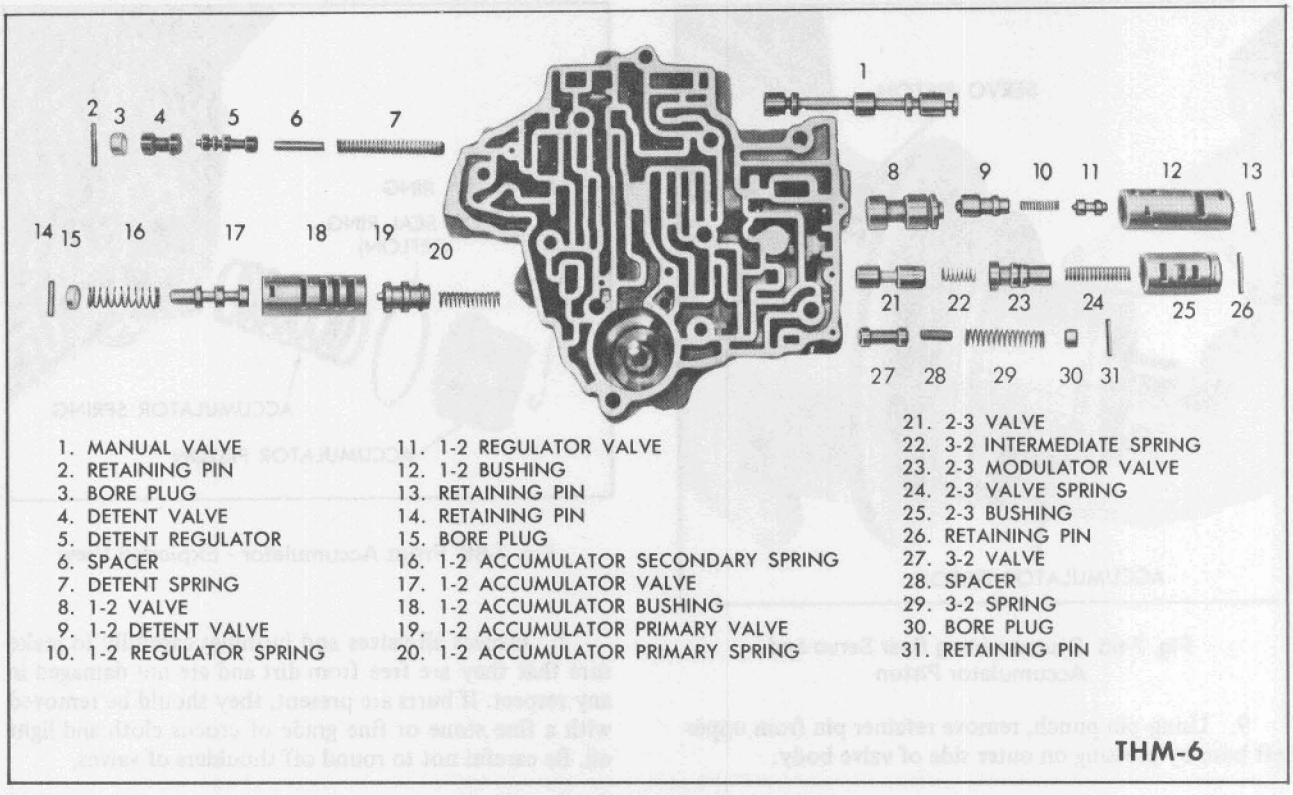


Fig. 7-63 Control Valve Assembly - Exploded

Assembly

1. Install sleeve to gear lip seal. (Trackmaster only)
2. Install C-wire retaining ring. (Trackmaster only)
3. Install O-ring on speedometer driven gear sleeve.
4. Install gear in sleeve.

16h. Control Valve Assembly (Fig. 7-63)

Disassembly

When disassembling control valve, make certain that springs are accurately identified so that they can be properly reassembled.

1. Position control valve assembly with cored face up and accumulator pocket on bottom.
2. Remove manual valve from upper bore.
3. Install Control Valve Accumulator Piston Installer, J-21885, on accumulator piston, compress piston and remove E-ring retainer, Fig. 7-64.
4. Remove Installer, J-21885, and remove accumulator piston and spring.
5. Using pin punch, remove retaining pin from upper right bore, pressing on pin from outer side of valve body. Remove 1-2 modulator bushing, 1-2 regulator valve and spring, 1-2 detent valve and 1-2 shift valve from upper right bore.

(NOTE: 1-2 regulator valve and spring may be inside of 1-2 modulator bushing.)

6. Using pin punch, remove retaining pin from center right bore, pressing on pin from outer side of valve body. Remove 2-3 modulator bushing, 2-3 shift valve spring, 2-3 modulator valve, 3-2 intermediate spring and 2-3 shift valve from center right bore.

(NOTE: 2-3 modulator valve will be inside of 2-3 modulator bushing.)

7. Using pin punch, remove retaining pin from lower right bore, pressing on pin from outer side of valve body.

CAUTION: Hold hand over bore when removing retainer pin as 3-2 valve spring may force bore plug out.

8. Remove bore plug, 3-2 valve spring, spacer and 3-2 valve from lower right bore.

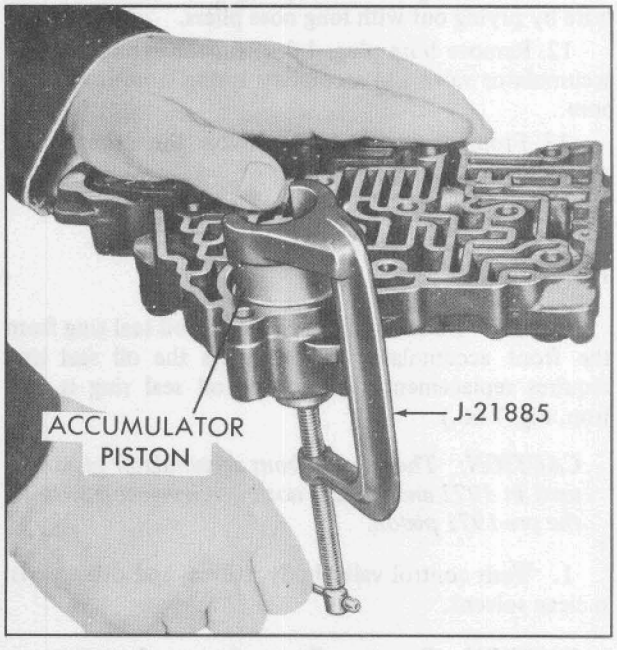


Fig. 7-64 Removing Front Accumulator Piston



Fig. 7-65 Disassembling Rear Servo and Accumulator Piston

9. Using pin punch, remove retainer pin from upper left bore by pressing on outer side of valve body.

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS DETENT REGULATOR VALVE SPRING MAY FORCE OTHER COMPONENTS OUT OF BORE.

10. Remove bore plug, detent valve, detent regulator valve, spacer and detent regulator valve spring from upper left bore.

11. Remove grooved retaining pin from lower left bore by prying out with long nose pliers.

12. Remove bore plug, 1-2 accumulator bushing, 1-2 accumulator valve and secondary spring from lower left bore.

13. From the same bore remove the primary 1-2 accumulator valve and spring.

Inspection

(NOTE: Do not remove the teflon oil seal ring from the front accumulator piston unless the oil seal ring requires replacement. The service oil seal ring is cast iron, Fig. 7-66.)

CAUTION: The type of front accumulator piston used in 1971 and 1972 is not interchangeable with the pre-1971 piston.

1. Wash control valve body, valves, and other parts in clean solvent.

CAUTION: Do not allow valves to bump together, as this might cause nicks and burrs.

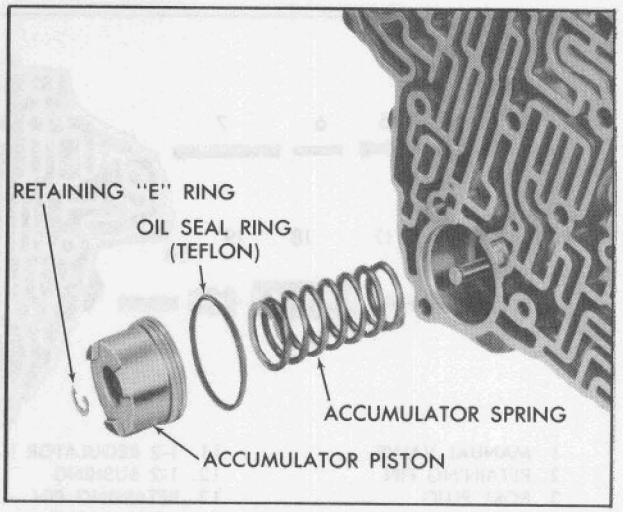


Fig. 7-66 Front Accumulator - Exploded View

2. Inspect all valves and bushings carefully to make sure that they are free from dirt and are not damaged in any respect. If burrs are present, they should be removed with a fine stone or fine grade of crocus cloth and light oil. Be careful not to round off shoulders of valves.

3. All valves and bushings should be tested in their individual bores to make certain that free movement can be obtained. All valves should fall freely of their own weight with a slight tapping action on the body. In checking, be careful to prevent valve damage in any way.

4. The manual valve is the only valve that can be serviced separately. If other valves are defective or damaged beyond repair, a new control valve assembly should be installed.

5. Inspect body for cracks or scored bores.

6. Check all springs for distortion or collapsed coils.

7. Inspect front accumulator piston and oil ring for damage.

Assembly

1. Position front accumulator spring and piston into valve body.

2. Install Control Valve Accumulator Piston Installer, J-21885, on piston. Compress spring and piston, aligning spring and piston with bore, Fig. 7-64.

CAUTION: Make certain that piston pin is correctly aligned with hole in piston and that oil seal ring does not catch on lip of bore when installing piston.

3. Secure piston and spring with E-ring retainer and remove Installer, J-21885.

4. Refer to Fig. 7-63, install 1-2 accumulator primary spring and 1-2 accumulator primary valve into

lower left bore. Push valve inward against spring and retain valve temporarily with pin inserted through drilled hole in valve body.

5. Install 1-2 accumulator bushing into bore.

6. Install 1-2 accumulator secondary valve, stem end out, into the 1-2 accumulator bushing.

7. Install 1-2 accumulator secondary spring over stem end of valve.

8. Install 1-2 accumulator bore plug into the 1-2 accumulator bushing.

9. Place control valve body on cored side, compress plug and install grooved retaining pin from cast surface side of valve body, with grooved end of pin entering hole last.

10. Tap retaining pin with hammer until pin is flush with cast surface, and remove temporary retaining pin. Return control valve assembly to its original position.

11. Insert spacer inside of detent regulator valve spring and install spring and spacer into upper left bore, making certain spring seats in bottom of bore.

12. Compress detent regulator valve spring and hold with a small screwdriver placed between end of spring and wall on cored side of valve body.

13. Install detent regulator valve, stem end out, and detent valve, small land first, into upper left bore.

14. Insert bore plug, hole out, into upper left bore and, pressing inward on bore plug, remove screwdriver and install retaining pin from cored side of valve body.

15. Install 3-2 valve in bottom right bore.

16. Insert spacer inside of 3-2 valve spring and install spring and spacer in bottom right bore.

17. Compressing 3-2 valve spring, install bore plug, hole end out, and secure with retaining pin from cored side of valve body.

18. Install 3-2 intermediate spring in open end of 2-3 shift valve, and install valve and spring, valve first, into center right bore. Make certain valve seats in bottom of bore.

19. Install 2-3 modulator valve, hole end first, into 2-3 modulator bushing and install both parts in center right bore.

20. Install 2-3 shift valve spring into hole in 2-3 modulator valve, and compressing spring, secure with retaining pin from cored side of control valve.

21 Install 1-2 shift valve, stem end out, in upper right bore, making certain valve seats in bottom of bore.

22. Install 1-2 regulator valve, larger stem first, spring and 1-2 detent valve, hole end first, into 1-2 modulator bushing, aligning spring in bore of 1-2 detent valve, and install in upper right bore of control valve body.

23. Compress bushing against spring and secure with retaining pin from cored side of control valve body.

24. Install manual valve with detent pin groove to the right.

16i. Rear Servo Assembly (Fig. 7-67)

Disassembly

1. Remove rear accumulator piston from rear servo piston. See Fig. 7-65.

2. Remove E-ring retaining rear servo piston to band apply pin.

3. Remove rear servo piston and seal from band apply pin.

4. Remove washer, spring and retainer.

Inspection

1. Check freeness of oil seal rings in piston grooves.

(NOTE: See Fig. 7-67. Do not remove the teflon oil seal rings from the rear accumulator piston, unless the oil seal rings requires replacement.

If the teflon inner oil seal ring, (small diameter) requires replacement, for service, use the aluminum oil seal ring.

The rear accumulator piston, large diameter ring groove depth, is machined shallower to take the large teflon oil seal ring, if this requires replacement, use only the teflon oil seal ring.)

2. Inspect fit of band apply pin in servo piston.

3. Inspect band apply pin for scores or cracks.

4. Inspect band apply pin for proper size as determined by pin selection check (Note 15g).

Assembly

1. Install spring retainer with cup side toward band apply servo pin, spring and washer on servo pin.

2. Install servo piston on pin and secure with E-ring retainer.

3. If removed, install oil seal ring on servo piston.

4. If removed, install outer and inner oil rings on accumulator piston.

5. Install accumulator piston into bore of servo piston.

16j. Front Servo Assembly (Fig. 7-68)

(NOTE: See Figure 7-68. Do not remove the teflon oil seal ring from the front servo piston unless the oil seal ring requires replacement. The service oil seal ring is aluminum.)

CAUTION: The spring retainer, servo pin, retainer ring and servo piston are identical for 1971 and 1972. These individual parts are not interchangeable with the pre-1971 parts.

Inspection

1. Inspect servo pin for damage.

2. Inspect piston and oil seal ring for damaged oil ring groove, check freedom of ring in groove.

3. Inspect piston for cracks or porosity.

4. Check fit of servo pin in piston.

Assembly

1. Reassemble parts of front servo, making sure tapered end of servo pin is pointing through the spring and spring retainer. Make sure the retainer ring is in the servo pin groove.

16k. Oil Pump Assembly

(NOTE: On service replacement pumps the cooler by-pass valve is not used.)

Disassembly

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116, place pump assembly in Holding Fixture with stator shaft pointing downward. Be careful not to damage shaft.

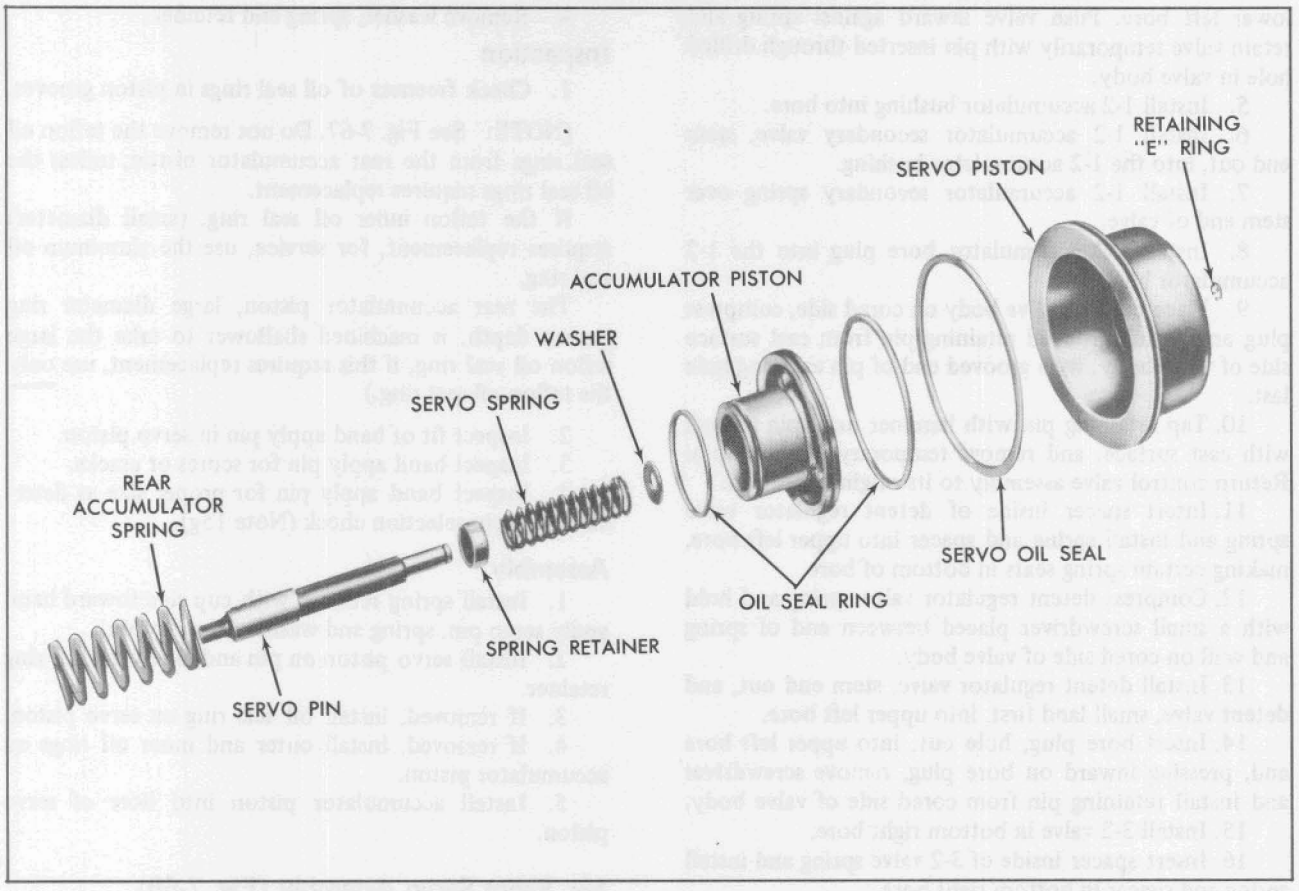


Fig. 7-67 Rear Servo and Accumulator - Exploded View

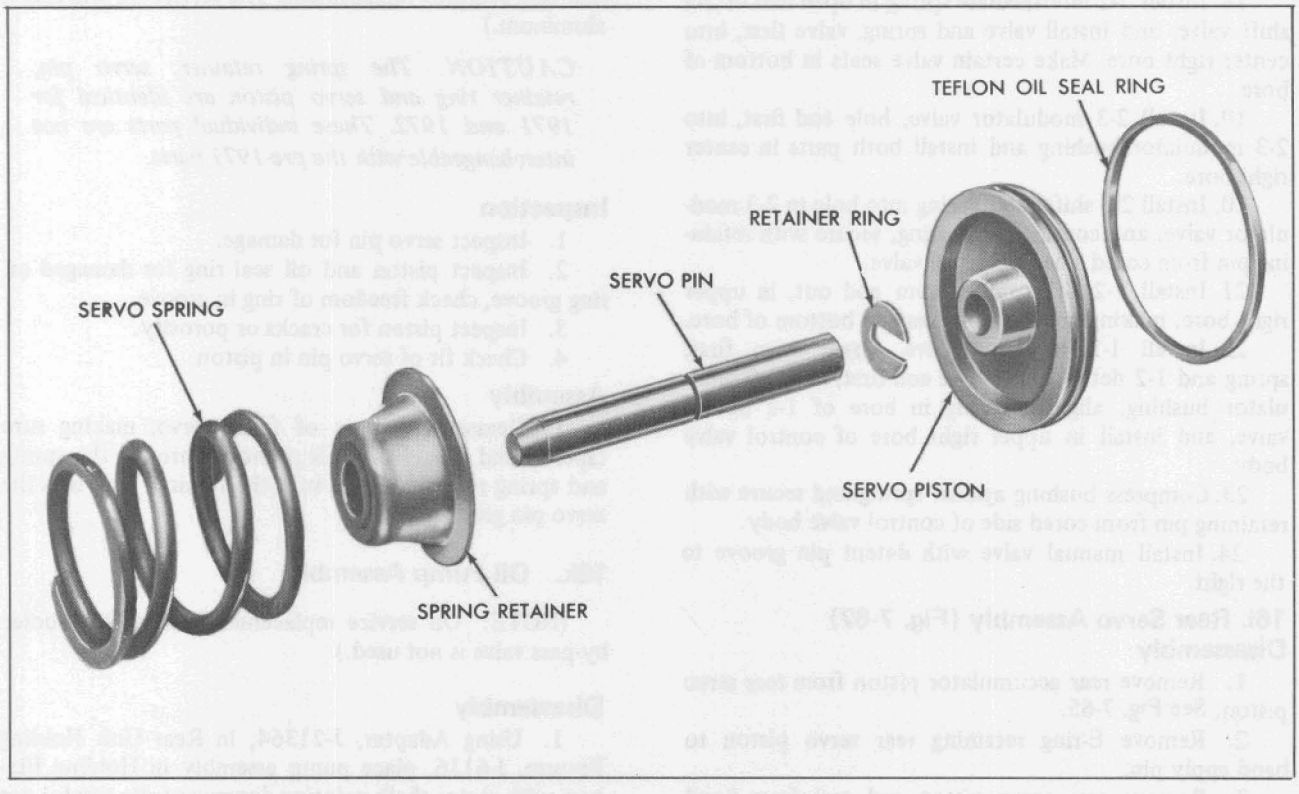


Fig. 7-68 Front Servo - Exploded View

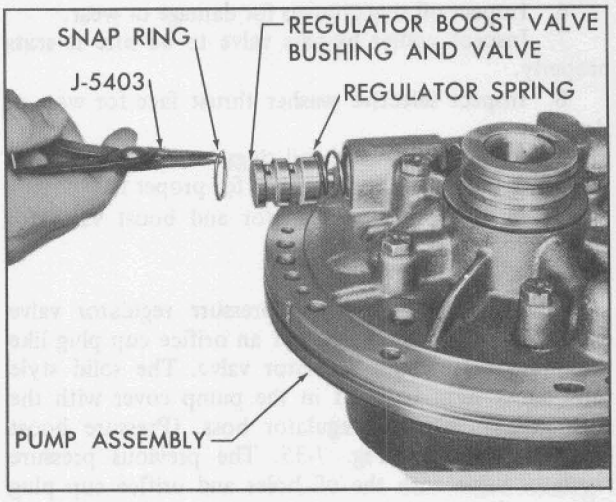


Fig. 7-69 Removing Pressure Regulator Valve Snap Ring

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring using Snap Ring Pliers J-5403 (#21), Fig. 7-69.

WARNING: PRESSURE REGULATOR SPRING IS UNDER EXTREME PRESSURE.

3. Remove regulator boost valve bushing and valve.
4. Remove pressure regulator spring.
5. Remove regulator valve, spring retainer, and spacer or spacers if present.
6. Remove five pump cover attaching screws and remove pump cover from body.
7. Mark drive and driven gears for reassembly in same position and remove from pump body, Fig. 7-70.

(NOTE: Installing the gears in the same position as removed, will assure the quietest operation, as the gear teeth will mesh in the established wear pattern.)

8. Remove retaining pin and bore plug from end of regulator bore.
9. Remove two oil rings from pump cover.
10. Remove pump to forward clutch housing selective washer.

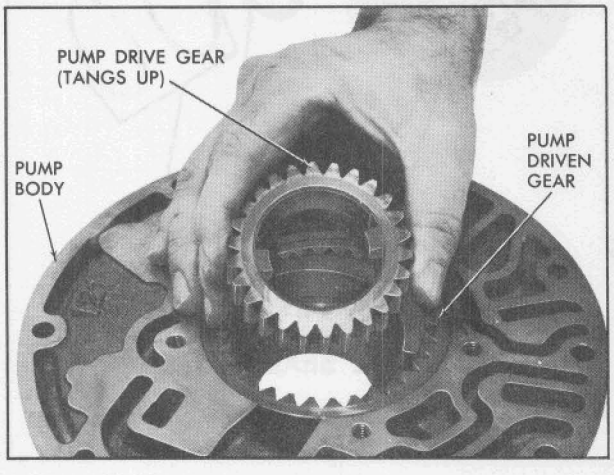


Fig. 7-70 Removing Pump Gears

(NOTE: Do not remove cooler by-pass valve seat in next step unless replacement of the seat, valve, or spring is necessary.)

The sealing qualities of the by-pass valve can be checked by pouring a small quantity of thinner or spirits into valve pocket and checking for excessive leakage.

11. If necessary, remove the cooler by-pass valve seat using Pump Check Valve Set Remover, J-21361, attached to Slide Hammer, J-6125-1, and Adapter J-6125-2, Fig. 7-71. Install remover tool in valve seat and drive upward on slide hammer to remove valve seat.

(NOTE: The seat may also be removed by threading the seat with 3/8-16 tap and using Adapter J-6125-2 on Slide Hammer, J-6125-1, to drive seat out. If this method is used, flush all foreign material and machining chips out of the by-pass valve bore before installing new seat.)

12. Remove by-pass valve and spring.
13. If necessary to replace front oil seal, pry seal from pump body, Fig. 7-37.

Inspection of Pump Body

1. Inspect gear pockets and crescent for scoring, galling or other damage.
2. Place pump gears in pump body and check pump body face to gear face clearance. Clearance should be .0008 inch - .0035 inch, Fig. 7-72.
3. Check face of pump body for scores or nicks.
4. Check oil passages for proper opening and lack of porosity.
5. Check for damaged cover bolt attaching threads.
6. Check for overall flatness of pump body face.
7. Check bushing for scores or nicks.

Inspection of Pump Cover (Fig. 7-73)

1. Inspect pump cover face for overall flatness.

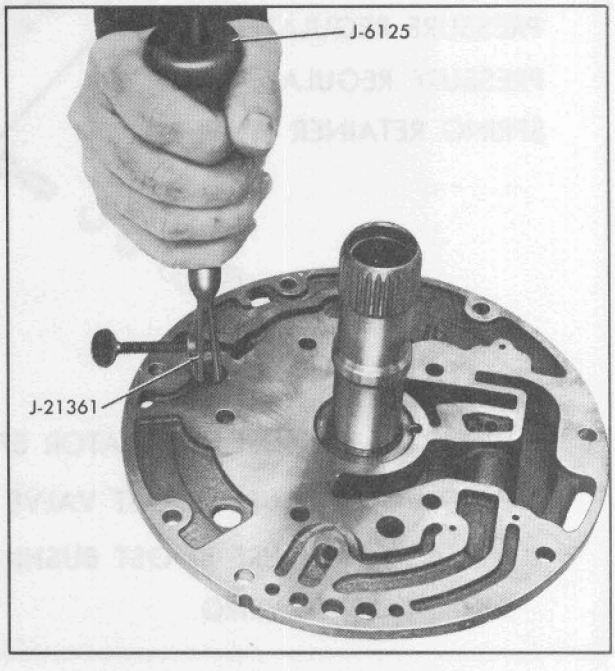


Fig. 7-71 Removing By-Pass Valve Seat

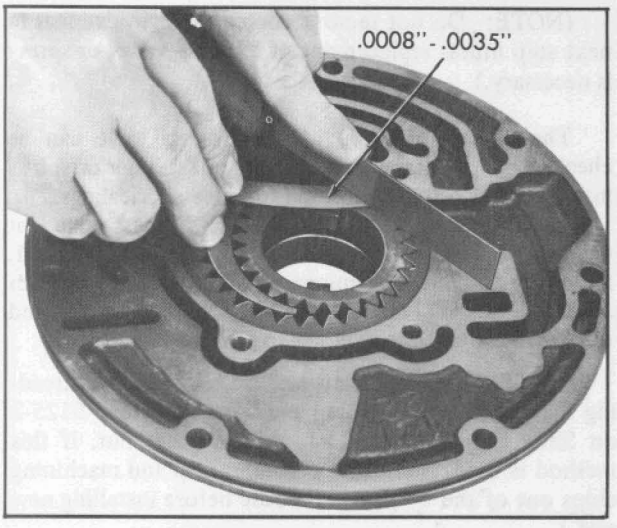


Fig. 7-72 Pump Body Face to Gear Face Clearance

2. Check for scores or dirt in pressure regulator bore.
3. Make certain all passages are open and not interconnected through porosity.
4. Check for scoring or damage at pump gear face.
5. Inspect stator shaft for damaged splines, or scored bushings.
6. Inspect oil ring grooves for damage or wear.
7. Inspect cooler by-pass valve to be sure it seats properly.
8. Inspect selective washer thrust face for wear or damage.
9. Install pump cover oil rings into counterbore at forward clutch housing and check for proper fit.
10. Inspect pressure regulator and boost valve for free operation.

(NOTE: The solid type pressure regulator valve does not contain oil holes and an orifice cup plug like the previous pressure regulator valve. The solid style valve must only be used in the pump cover with the squared off pressure regulator boss, (Pressure boost bushing end). See Fig. 7-35. The previous pressure regulator valve with the oil holes and orifice cup plug will be used to service either type pump cover.)

11. Inspect pump cover for open 1/8 inch diameter breather hole.

Assembly

1. Install drive and driven pump gears into pump body with alignment marks up and mated. In this position the pump gear drive tangs will also be up.
2. Install pressure regulator spacer or spacers, if

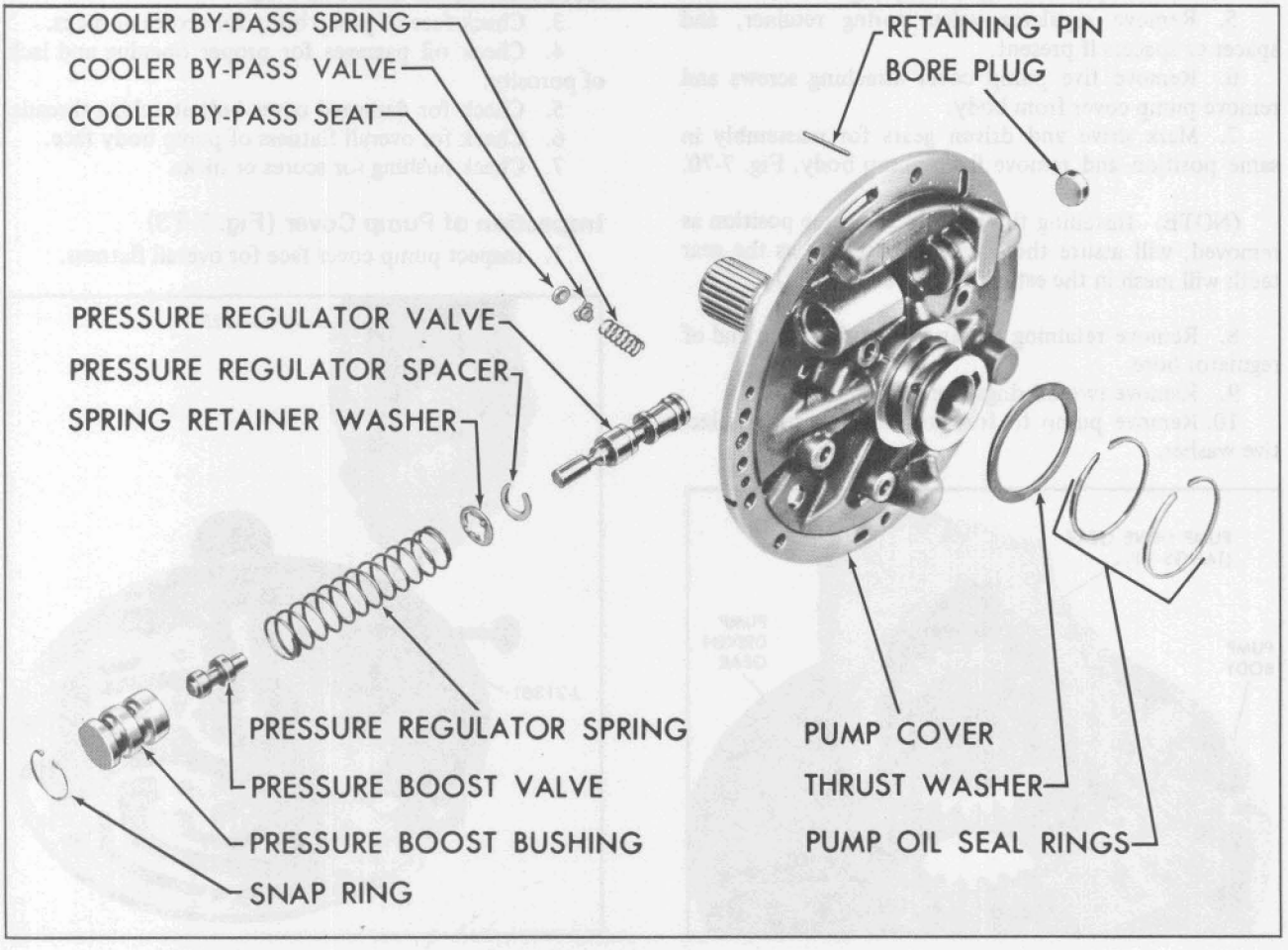


Fig. 7-73 Pump Cover - Exploded View

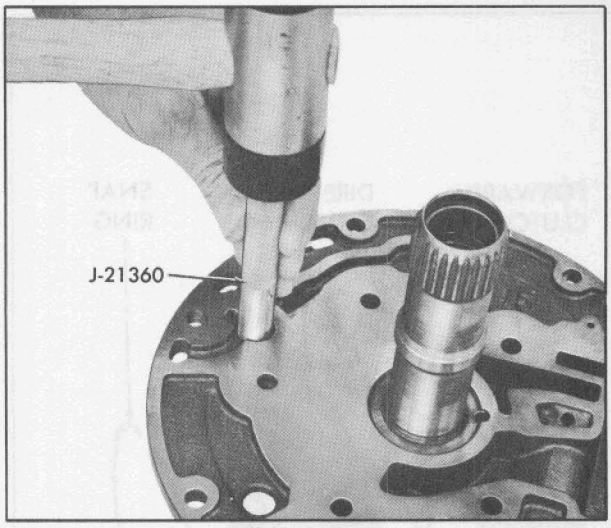


Fig. 7-74 Installing By-Pass Valve Seat

required, spring retainer and spring into pressure regulator bore.

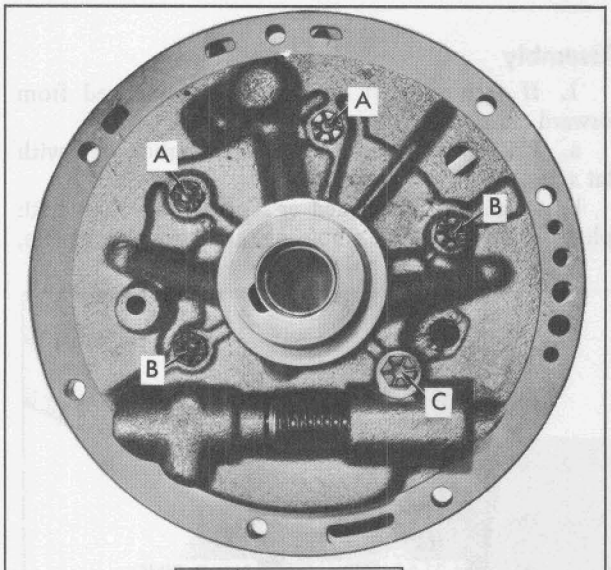
3. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring.

4. Install retaining snap ring.

5. Install pressure regulator valve from opposite end of bore, stem end first.

6. Install pressure regulator valve bore plug and retaining pin into end of bore.

7. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.



BOLT	SIZE
A -	5/16 - 18 x 1
B -	5/16 - 18 x 1½
C -	5/16 - 18 x 1¾

Fig. 7-75 Pump Cover Attaching Screws

(NOTE: Proper washer size was determined at time of front unit end play check (Note 15j).)

8. Install two hook type oil seal rings.

9. If previously removed, install cooler by-pass valve spring (large end first), valve, and valve seat. Use Pump Check Valve Seat Installer, J-21360, Fig. 7-74, to install valve seat.

10. Place pump body in Rear Unit Holding Fixture, J-6116, with cored passages facing up.

11. Lubricate pump gears with transmission fluid and install pump cover on pump body.

12. Install pump cover attaching screws following screw chart, Fig. 7-75. Leave screws one turn loose at this time.

13. Install pump Body and Cover Alignment Band, J-21368, around pump assembly. Tighten wing nut on alignment band to align pump cover with pump body, Fig. 7-76.

14. Tighten pump cover attaching screws to 18 foot-pounds and remove alignment band from pump.

15. Install new square cut O-ring on pump.

16. If necessary, install new pump oil seal using pump Oil Seal Installer, J-21359, Fig. 7-38.

16l. Forward Clutch Assembly-Disassembly

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116, place forward clutch assembly in Holding Fixture with turbine shaft pointing downward. Be careful not to damage shaft.

2. Remove forward clutch housing to direct clutch hub snap ring.

3. Remove direct clutch hub.

4. Remove forward clutch hub and one thrust washer from each side of hub, Fig. 7-77.

5. Remove five composition and five steel clutch plates.

6. Place forward clutch assembly in arbor press with turbine shaft pointing downward.

7. Using Clutch Spring Compressor, J-4670, and Adapter, J-21664, compress spring retainer with arbor

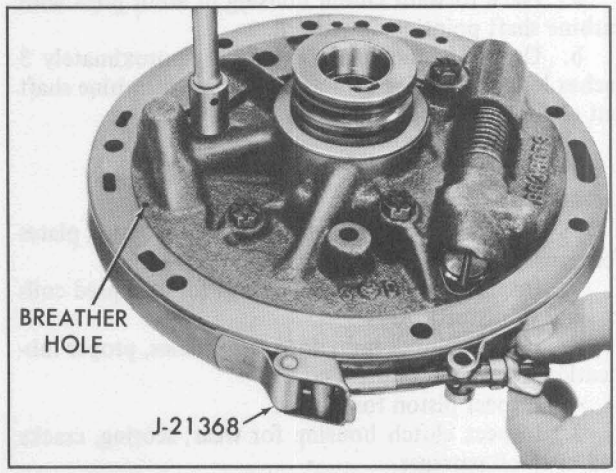


Fig. 7-76 Aligning Pump Cover and Body

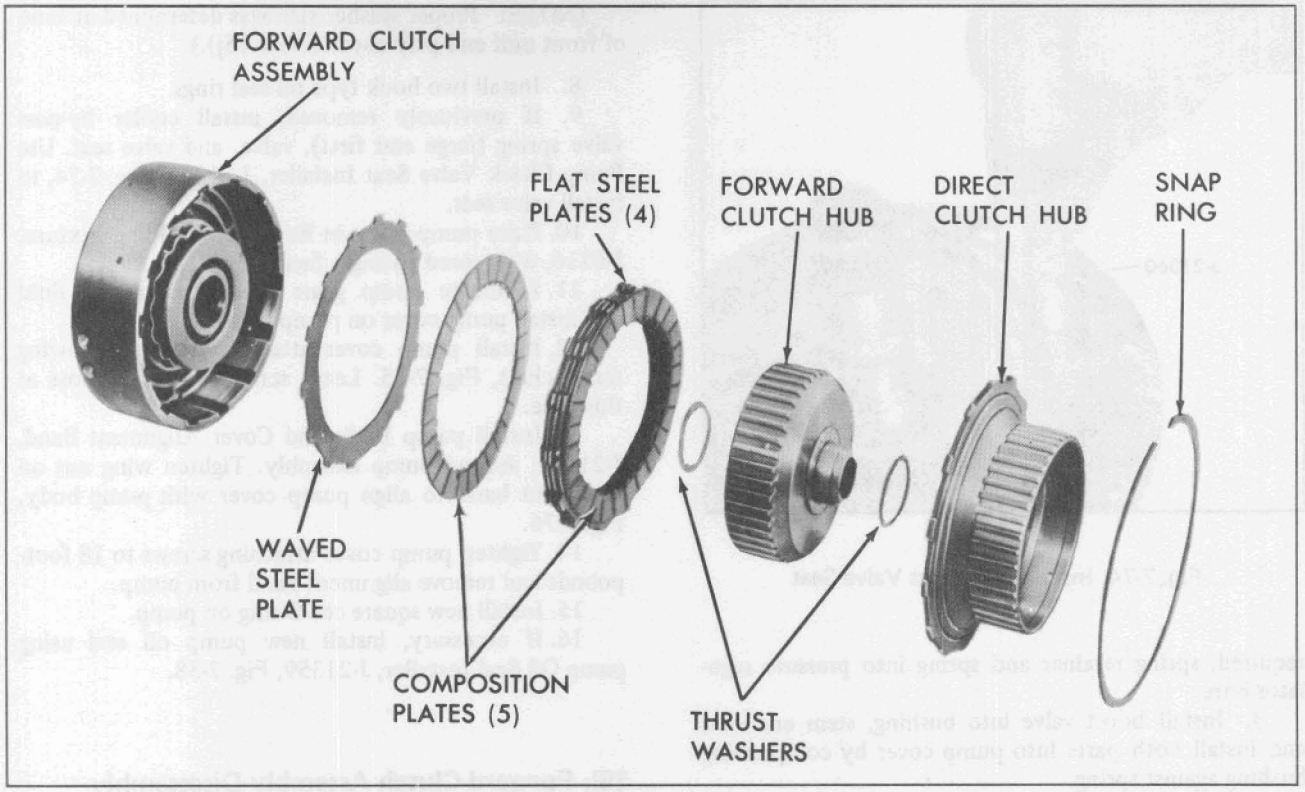


Fig. 7-77 Forward and Direct Clutches - Exploded View

press and remove snap ring using Snap Ring Pliers, J-8059 or J-5586, Fig. 7-78.

8. Remove tools, spring retainer and 16 clutch release springs. Keep springs separate from direct clutch springs.

9. Remove forward clutch piston from forward clutch housing.

10. Remove inner and outer seals from clutch piston.

11. Remove center piston seal from forward clutch housing.

12. It is not necessary to remove turbine shaft from forward clutch housing unless either shaft or housing is damaged and must be replaced. In such case proceed as follows:

a. Place forward clutch housing in arbor press with turbine shaft pointing downward.

b. Using 3/8 inch drive extension approximately 3 inches long, or similar tool as driver, press turbine shaft out of forward clutch housing.

Inspection

1. Inspect composition faced and steel clutch plates for signs of burning, scoring or wear.

2. Inspect sixteen release springs for collapsed coils or signs of distortion.

3. Inspect clutch hubs for worn splines, proper lubrication holes, and thrust faces.

4. Inspect piston for cracks.

5. Inspect clutch housing for wear, scoring, cracks and open oil passages.

6. Inspect operation of ball check in forward clutch housing.

7. Inspect turbine shaft for open lubrication passages at each end.

8. Inspect turbine shaft splines for damage.

9. Inspect bushing journals for damage.

10. Inspect turbine shaft for cracks or distortion.

Assembly

1. If turbine shaft was previously removed from forward clutch housing proceed as follows:

a. Place forward clutch housing on arbor press with flat side up.

b. Align shorter splined end of turbine shaft with splines in forward clutch housing, and using arbor press,

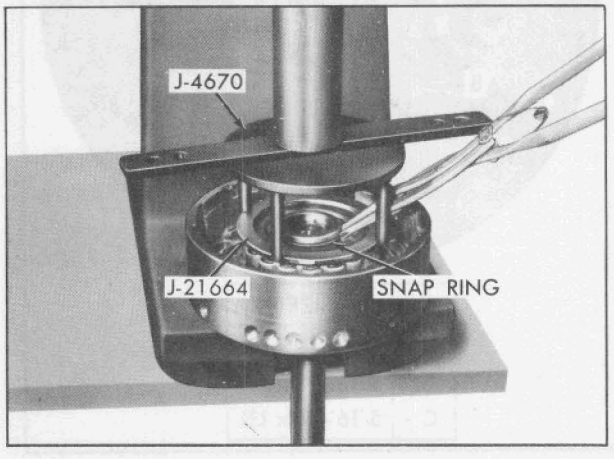


Fig. 7-78 Removing Forward Clutch Snap Ring

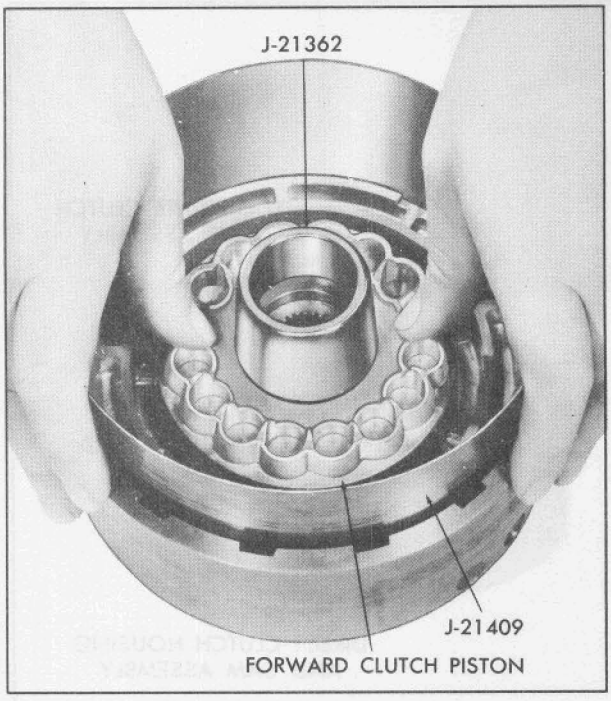


Fig. 7-79 Installing Forward Clutch Piston

carefully press shaft into housing until shaft bottoms on hub of housing.

CAUTION: Start shaft into housing and back off on arbor press to allow shaft to straighten itself. Repeat this step several times until you are certain shaft is going in straight, otherwise, shaft or housing splines may be damaged.

2. Invert forward clutch housing on arbor press with turbine shaft pointing downward.

3. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in forward clutch piston with petrolatum and install seals with lips facing away from spring pockets.

(NOTE: The forward and direct clutch pistons have identical inside and outside diameters. Therefore, extreme care should be exercised during reassembly to assure the proper piston be installed in the clutch assemblies.

The forward clutch piston can be identified by the absence of a check ball in the clutch apply face of the piston.)

4. Lubricate new center piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and install seal into clutch housing with lip facing up.

5. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over forward clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in forward clutch housing, Fig. 7-79, and install clutch piston by rotating it slightly in a clockwise direction until seated.

6. Install sixteen clutch release springs into spring pockets in clutch piston.

7. Using Clutch Spring Compressor, J-4670, and Adapter, J-21664, compress spring retainer with arbor press, being careful that retainer does not catch in snap ring groove, and install snap ring using Snap Ring Pliers, J-8059 or J-5586, Fig. 7-78. Remove tools.

CAUTION: Make certain clutch release springs are not leaning. If necessary, straighten with a small screwdriver.

8. Remove forward clutch assembly from arbor press and place in Holding Fixture, J-6116, with turbine shaft pointing down. Be careful not to damage shaft.

9. Install thrust washer on the outside of forward clutch hub. The bronze washer is installed on side of hub facing forward clutch housing.

10. Install forward clutch hub in forward clutch housing.

11. Lubricate the four flat steel, five composition and one waved U-notched steel clutch plates with transmission fluid and install clutch plates in forward clutch housing, Fig. 7-77. Start with waved steel plate and alternate composition and steel plates.

12. Install direct clutch hub in forward clutch housing over clutch plates, and install snap ring.

13. Place forward clutch housing on pump delivery sleeve and air check clutch operation by applying air through forward clutch passage in pump, Fig. 7-80, to actuate piston and move forward clutch.

16m. Direct Clutch and Intermediate Roller Assembly (Fig. 7-82)

Disassembly

1. Remove roller retainer snap ring, and remove clutch retainer.

2. Remove roller outer race and remove roller assembly. See Fig. 7-81.

3. Turn unit over and remove direct clutch backing plate to clutch housing snap ring.

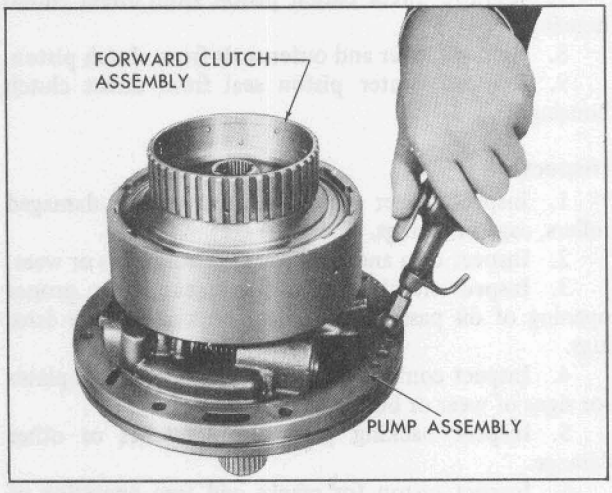


Fig. 7-80 Air Checking Forward Clutch

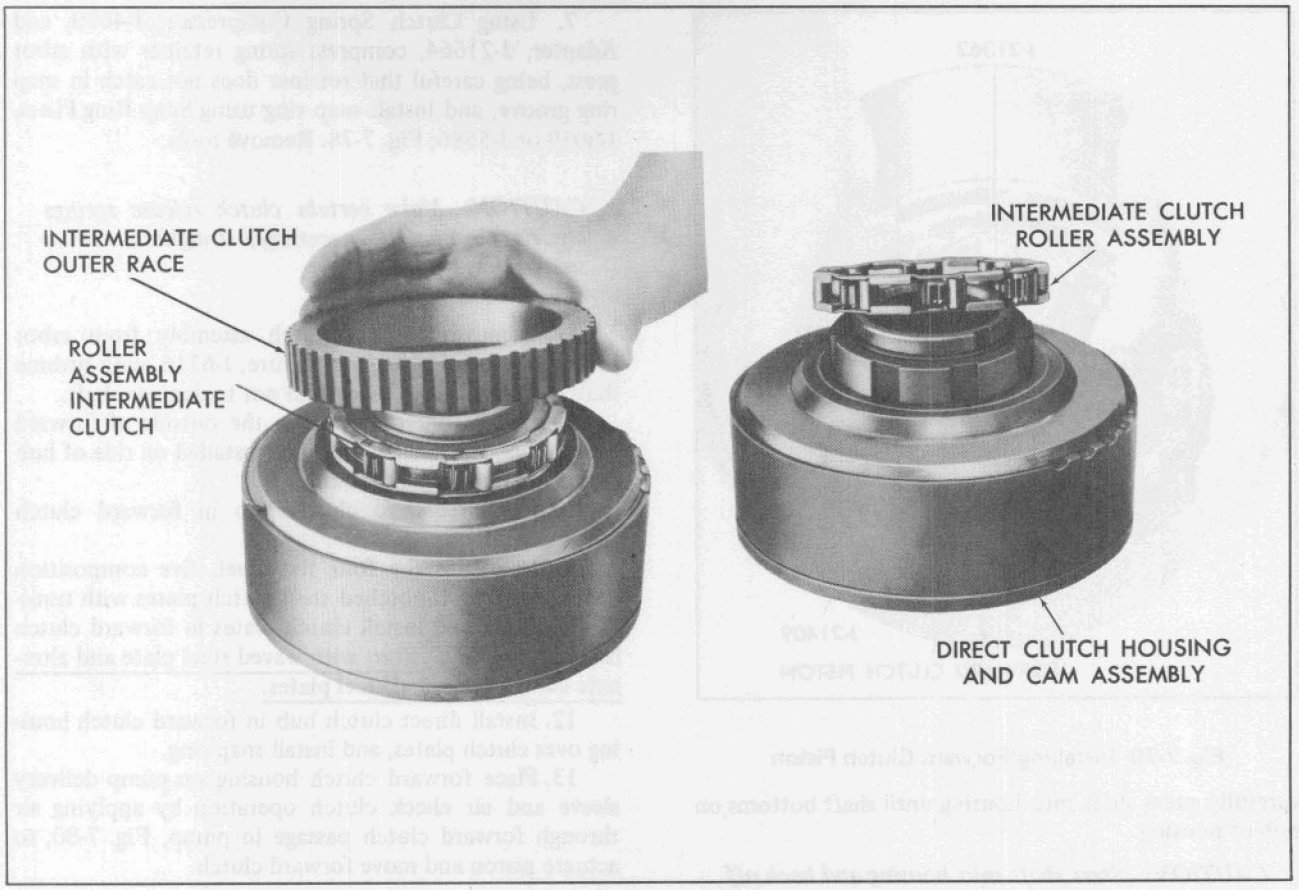


Fig. 7-81 Removing Roller Outer Race and Assembly

4. Remove direct clutch backing plate and six composition and six steel clutch plates, Fig. 7-83.

5. Using Clutch Spring Compressor, J-4670, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, Fig. 7-84, compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586.

6. Remove tools, spring retainer and 14 clutch release springs. Keep springs separate from forward clutch springs.

7. Remove direct clutch piston from direct clutch housing.

8. Remove inner and outer seals from clutch piston.

9. Remove center piston seal from direct clutch housing.

Inspection

1. Inspect roller clutch assembly for damaged rollers, cage or springs.

2. Inspect cam and outer race for scratches or wear.

3. Inspect clutch housing for cracks, wear, proper opening of oil passages and wear on clutch plate drive lugs.

4. Inspect composition-faced and steel clutch plates for signs of wear or burning.

5. Inspect backing plate for scratches or other damage.

6. Inspect piston for cracks and free operation of check ball.

7. Inspect springs for collapsed coils or signs of distortion.

(NOTE: The 14 direct clutch release springs are not serviced individually. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.)

Assembly

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in direct clutch piston and install seals with lips facing away from spring pockets.

(NOTE: Make certain piston has check ball.)

2. Lubricate new center seal with transmission fluid. Lubricate seal groove in direct clutch housing and install seal in clutch housing with lip facing up.

3. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over direct clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in direct clutch housing, Fig. 7-85, and install clutch piston by rotating it slightly, in a clockwise direction.

4. Install 16 clutch release springs into spring pockets in clutch piston.

5. Place spring retainer and snap ring over springs.

6. Using Clutch Spring Compressor, J-4670, Rear Clutch Spring Compressor, J-6129, or an arbor press,

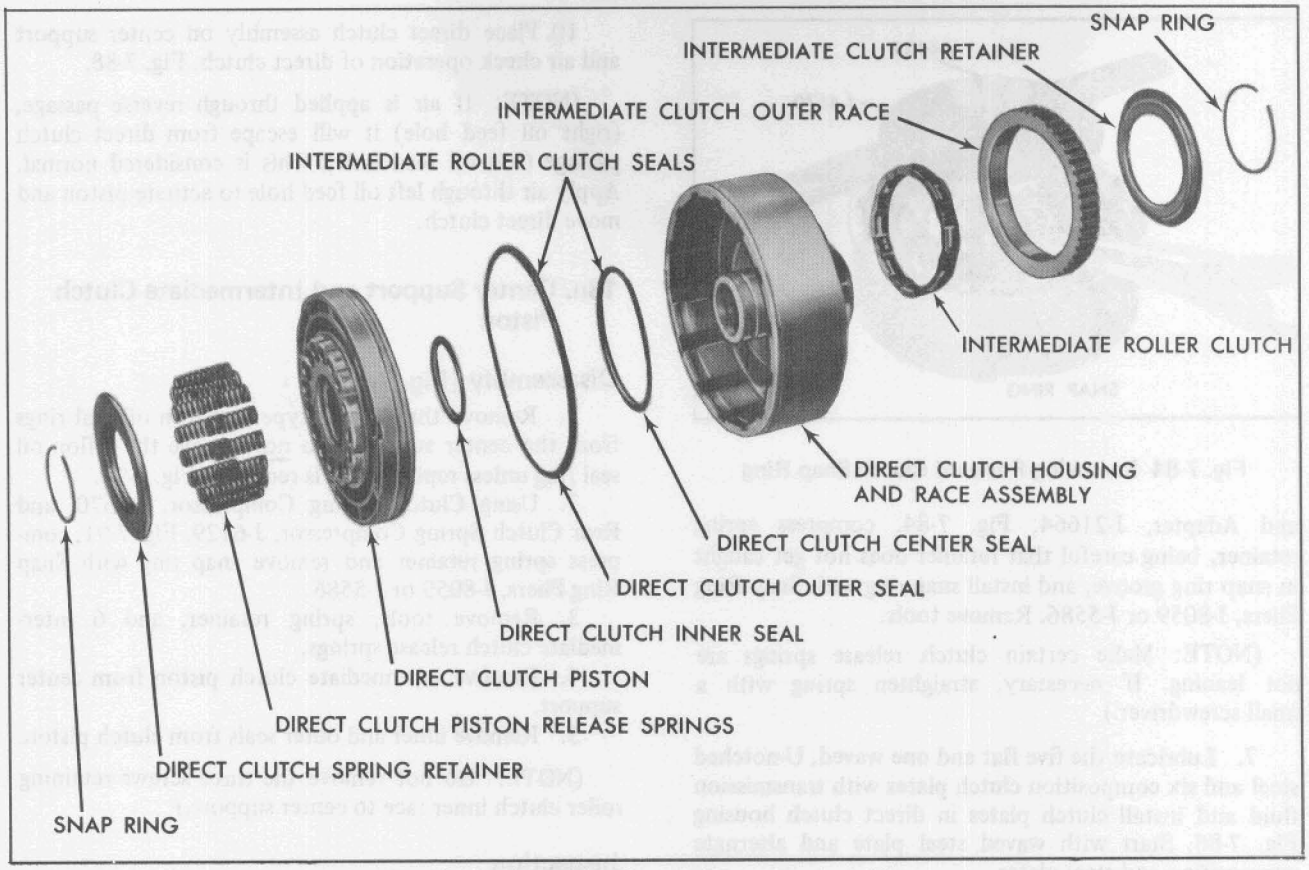


Fig. 7-82 Direct Clutch and Piston - Exploded View

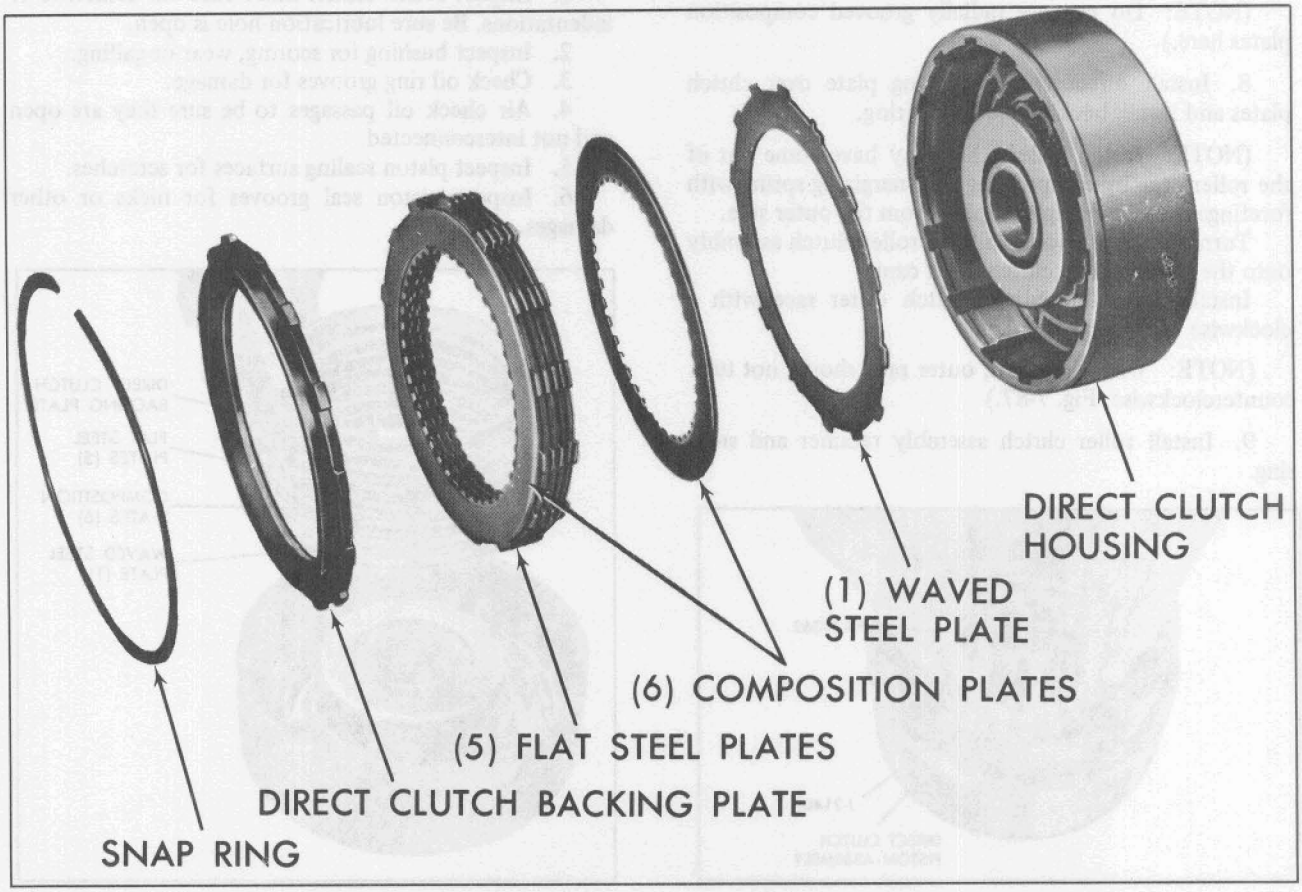


Fig. 7-83 Direct Clutch - Exploded View

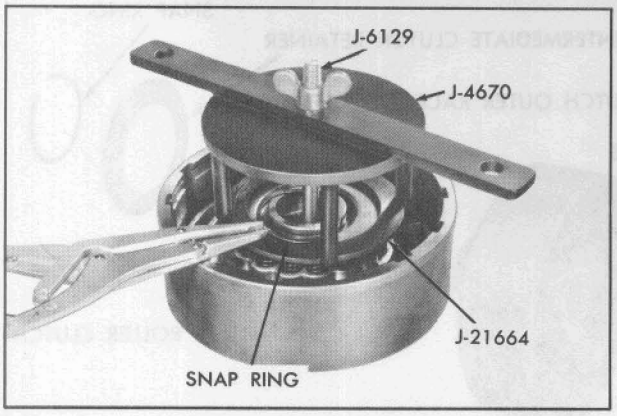


Fig. 7-84 Removing Forward Clutch Snap Ring

and Adapter, J-21664, Fig. 7-84, compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586. Remove tools.

(NOTE: Make certain clutch release springs are not leaning. If necessary, straighten spring with a small screwdriver.)

7. Lubricate the five flat and one waved, U-notched steel and six composition clutch plates with transmission fluid and install clutch plates in direct clutch housing Fig. 7-86. Start with waved steel plate and alternate composition and steel plates.

(NOTE: Do not use radially grooved composition plates here.)

8. Install direct clutch backing plate over clutch plates and install backing plate snap ring.

(NOTE: Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting the roller from the outer side.

Turn unit over and install the roller clutch assembly onto the intermediate clutch inner cam.

Install the intermediate clutch outer race with a clockwise turning motion.)

(NOTE: When installed, outer race should not turn counterclockwise, Fig. 7-87.)

9. Install roller clutch assembly retainer and snap ring.

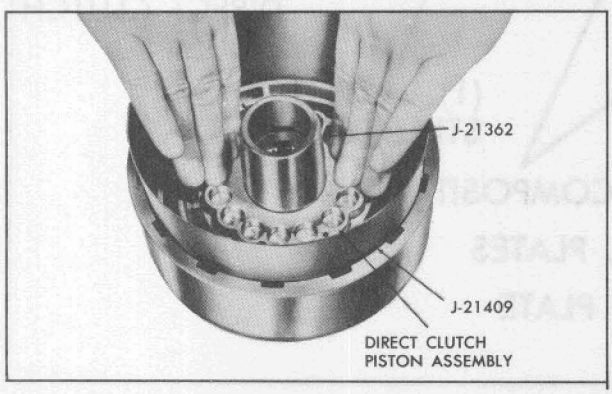


Fig. 7-85 Installing Direct Clutch Piston

10. Place direct clutch assembly on center support and air check operation of direct clutch, Fig. 7-88.

(NOTE: If air is applied through reverse passage, (right oil feed hole) it will escape from direct clutch passage (left oil feed hole). This is considered normal. Apply air through left oil feed hole to actuate piston and move direct clutch.

16n. Center Support and Intermediate Clutch Piston

Disassembly (Fig. 7-89)

1. Remove three hook type cast iron oil seal rings from the center support. Do not remove the teflon oil seal ring unless replacement is required, Fig. 7-90.
2. Using Clutch Spring Compressor, J-4670, and Rear Clutch Spring Compressor, J-6129, Fig. 7-91, compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586.
3. Remove tools, spring retainer, and 6 intermediate clutch release springs.
4. Remove intermediate clutch piston from center support.
5. Remove inner and outer seals from clutch piston.

(NOTE: Do not remove the three screws retaining roller clutch inner race to center support.)

Inspection

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open.
2. Inspect bushing for scoring, wear or galling.
3. Check oil ring grooves for damage.
4. Air check oil passages to be sure they are open and not interconnected.
5. Inspect piston sealing surfaces for scratches.
6. Inspect piston seal grooves for nicks or other damages.

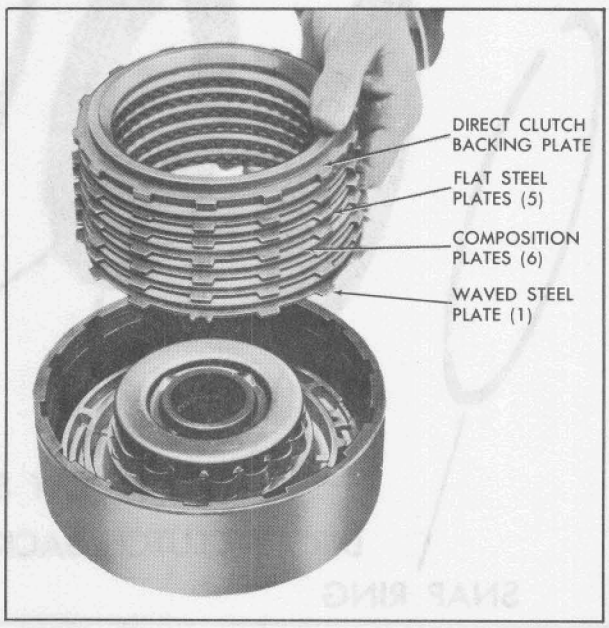


Fig. 7-86 Installing Direct Clutch Plates

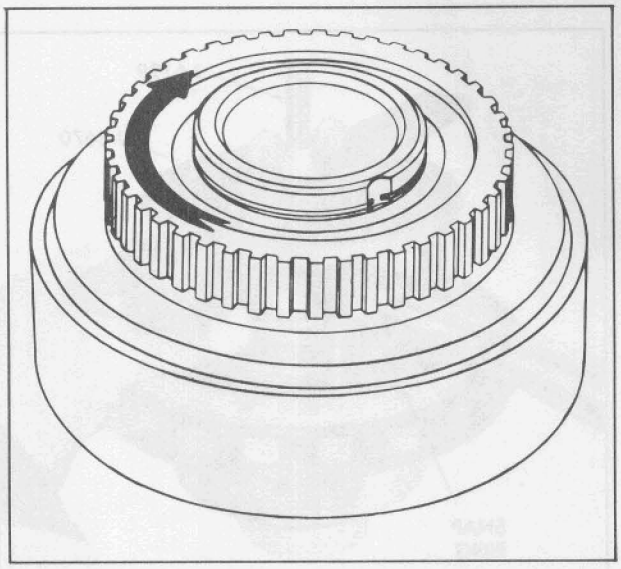


Fig. 7-87 Roller Clutch Rotation

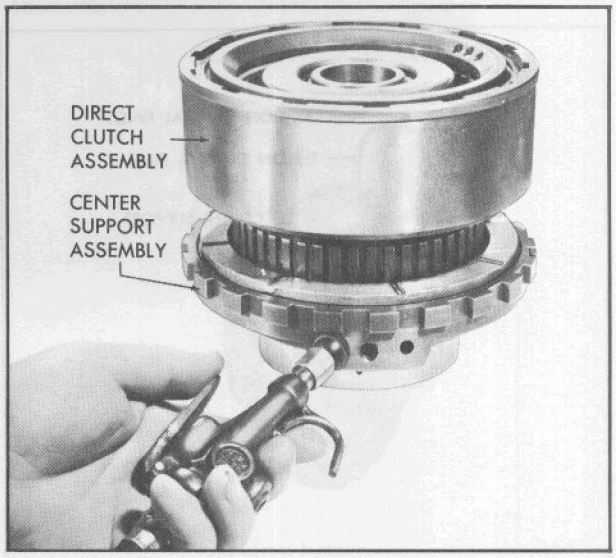


Fig. 7-88 Air Checking Direct Clutch

7. Inspect piston for cracks or porosity.
8. Inspect springs for collapsed coils or signs of distortion.

(NOTE: The six intermediate clutch release springs are not serviced individually. If one or more of these springs require replacement, discard all of them and install the 12 service intermediate clutch release springs.)

9. Inspect oil seal rings for damage.

(NOTE: All service center support oil seal rings are hook type cast iron.)

Assembly

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in intermediate clutch piston and install seals with lips facing away from spring pockets.
2. Place Intermediate Clutch Inner Seal Protector, J-21363, over center support hub, Fig. 7-92, and install intermediate clutch piston, making certain it fully seats in center support. Remove J-21363.
3. Install 6 clutch release springs, space equally, into spring pockets in clutch piston.
4. Place spring retainer and snap ring over springs.

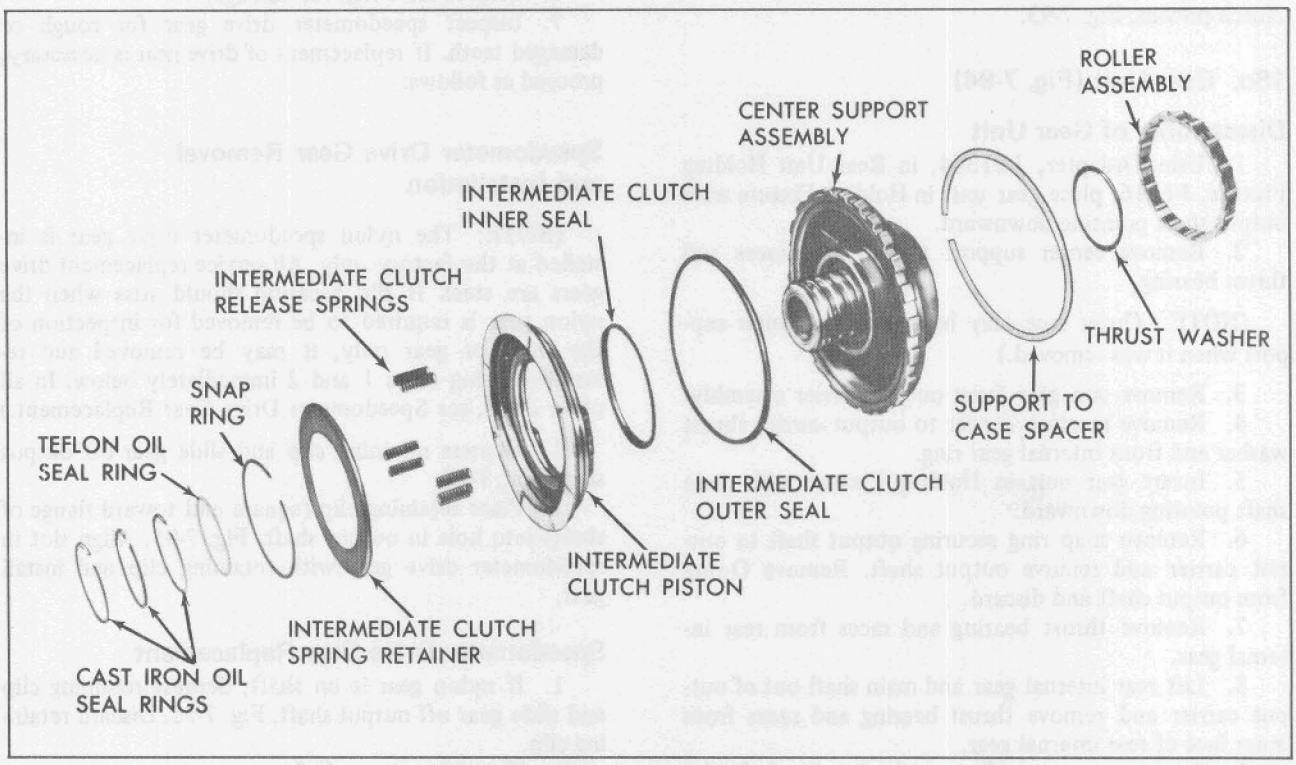


Fig. 7-89 Center Support Assembly - Exploded View

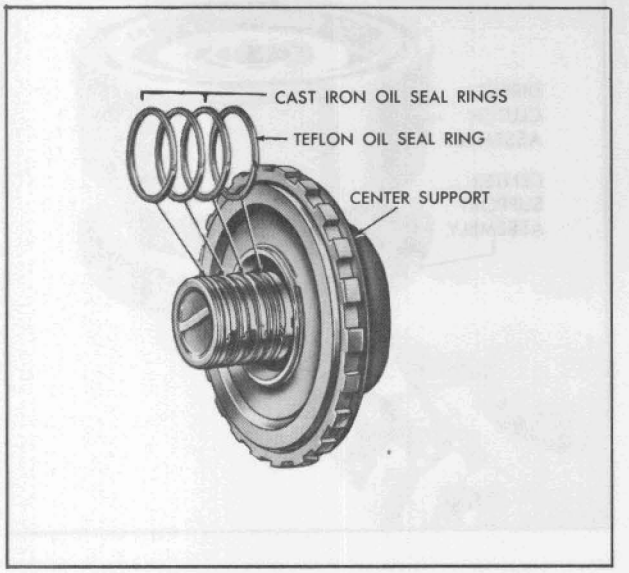


Fig. 7-90 Center Support Seal Rings

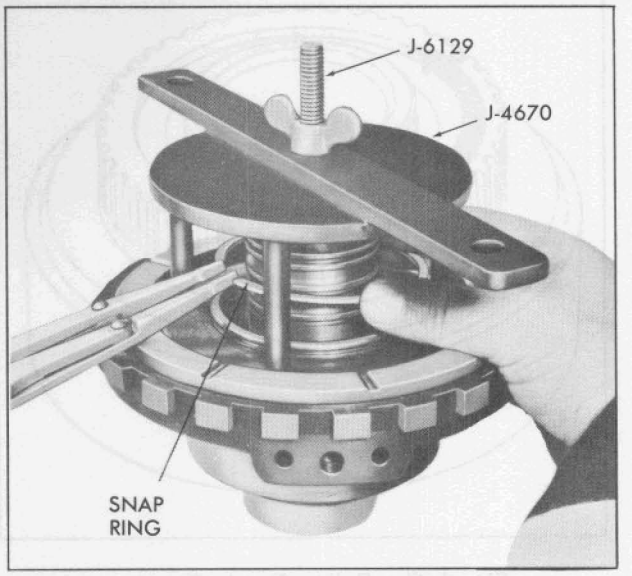


Fig. 7-91 Removing Intermediate Clutch Snap Ring

5. Position snap ring and using Clutch Spring Compressor, J-4670, and Rear Clutch Spring Compressor, J-6129, Fig. 7-91, compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586. Remove tools.

6. Install three hook type cast iron oil seal rings on the center support if the teflon ring was not removed. If the teflon ring was removed, install four hook type cast iron oil seal rings.

7. Air check operation of intermediate clutch piston, Apply air through center oil feed hole to actuate clutch pistons, Fig. 7-93.

16o. Gear Unit (Fig. 7-94)

Disassembly of Gear Unit

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116, place gear unit in Holding Fixture with output shaft pointing downward.

2. Remove center support to sun gear races and thrust bearing.

(NOTE: Outer race may have stuck to center support when it was removed.)

3. Remove sun gear from output carrier assembly.

4. Remove reaction carrier to output carrier thrust washer and front internal gear ring.

5. Invert gear unit in Holding Fixture with main shaft pointing downward.

6. Remove snap ring securing output shaft to output carrier and remove output shaft. Remove O-ring from output shaft and discard.

7. Remove thrust bearing and races from rear internal gear.

8. Lift rear internal gear and main shaft out of output carrier and remove thrust bearing and races from inner face of rear internal gear.

9. Remove snap ring from end of main shaft and remove rear internal gear.

10. Remove output carrier from Holding Fixture.

Inspection of Output Shaft

1. Inspect bushing for wear or galling.

2. Inspect bearing and thrust washer surfaces for damage.

3. Inspect governor drive gear for rough or damaged teeth.

4. Inspect splines for damage.

5. Inspect orificed cup plug in the lubrication passage.

6. Inspect drive lugs for damage.

7. Inspect speedometer drive gear for rough or damaged teeth. If replacement of drive gear is necessary, proceed as follows:

Speedometer Drive Gear Removal and Installation

(NOTE: The nylon speedometer drive gear is installed at the factory only. All service replacement drive gears are steel. If the occasion should arise when the nylon gear is required to be removed for inspection of the shaft or gear only, it may be removed and reinstalled using steps 1 and 2 immediately below. In all other cases, see Speedometer Drive Gear Replacement.)

1. Depress retaining clip and slide gear off output shaft, Fig. 7-95.

2. Place retaining clip (square end toward flange of shaft) into hole in output shaft, Fig. 7-95. Align slot in speedometer drive gear with retaining clip and install gear.

Speedometer Drive Gear Replacement

1. If nylon gear is on shaft, depress retaining clip and slide gear off output shaft, Fig. 7-95. Discard retaining clip.

2. If steel gear is on shaft:

a. Install Speedometer Drive Gear Remover,

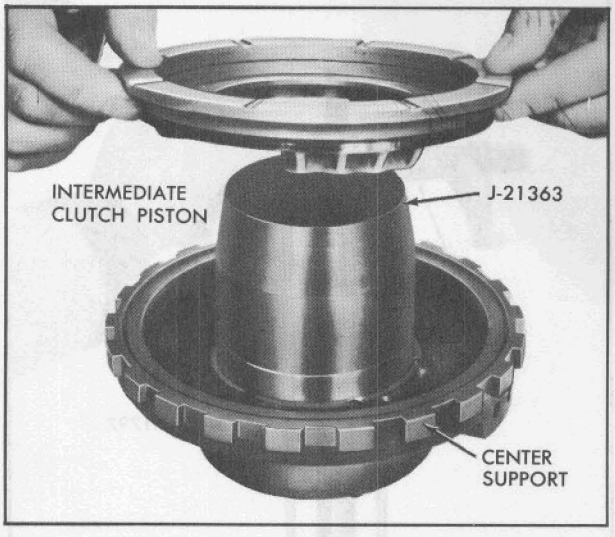


Fig. 7-92 Installing Intermediate Clutch Piston

J-21427, with Pulley Puller, J-8433, and attach, using Speedometer Drive Gear Remover Bolts, J-21797, on output shaft so that puller bolt indexes with end of shaft and flat face of remover tool is under front face of drive gear.

b. Tighten bolt on Pulley Puller, Fig. 7-96, until gear is free on shaft. Remove tools and gear from shaft.

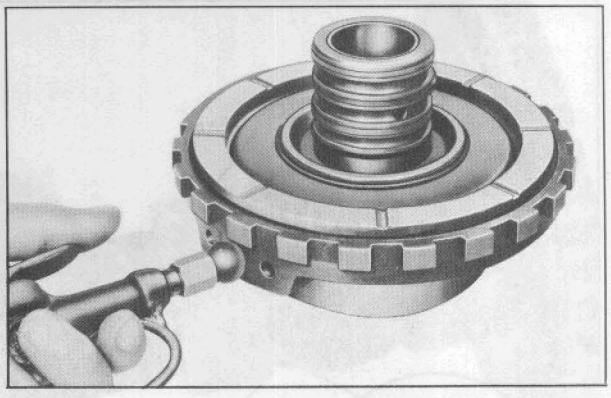


Fig. 7-93 Air Checking Intermediate Clutch

3. Support output shaft and install new steel speedometer drive gear using a piece of pipe.

CAUTION: Use a pipe that closely fits output shaft and does not contact gear teeth. Contact with gear teeth would result in damage to the gear as it is driven into place.

4. Drive gear onto shaft until distance from rear face of gear to end of output shaft is 15 inches, Fig. 7-97.

Inspection of Main Shaft

1. Inspect shaft for cracks or distortion.

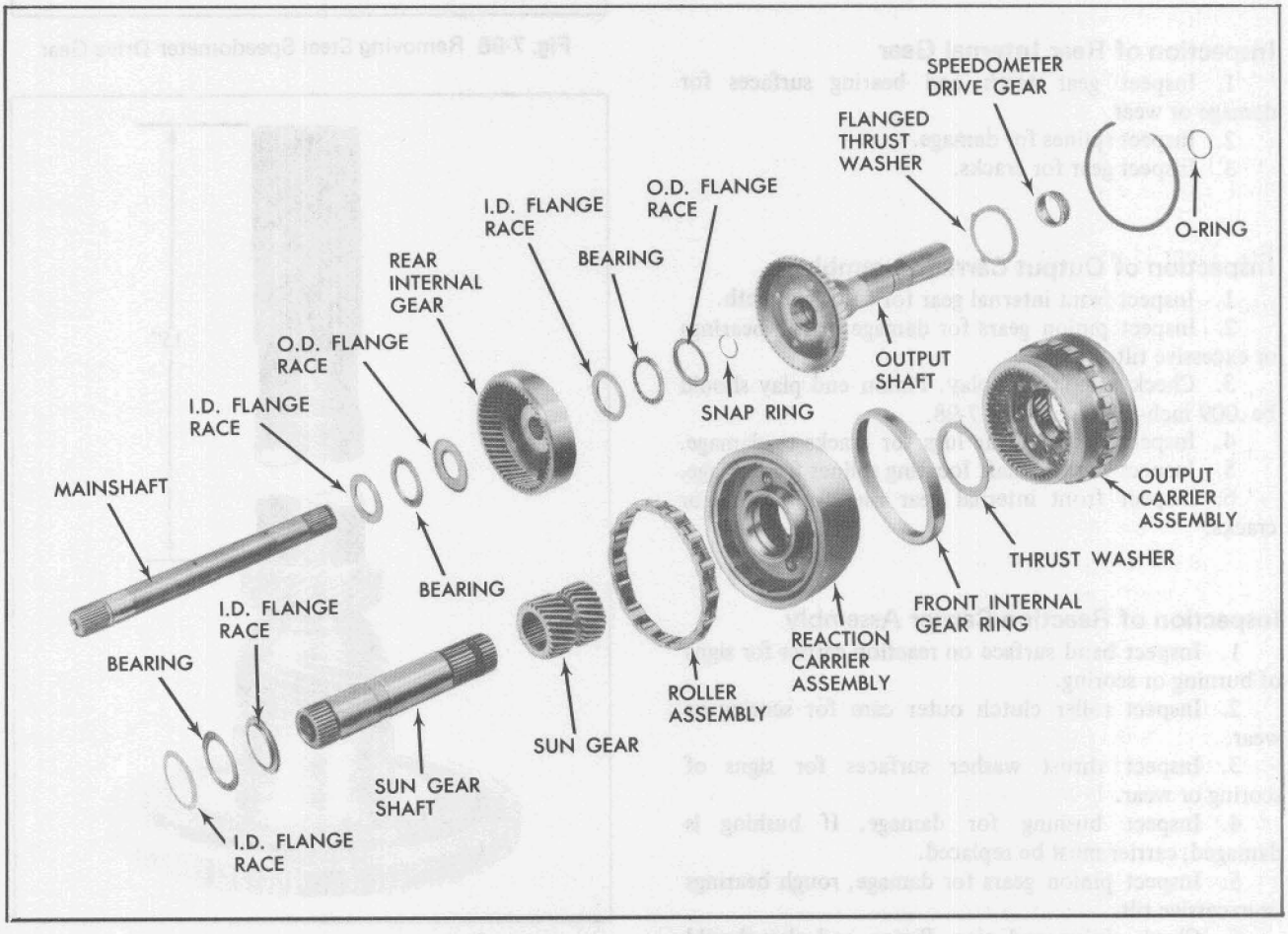


Fig. 7-94 Gear Unit - Exploded View

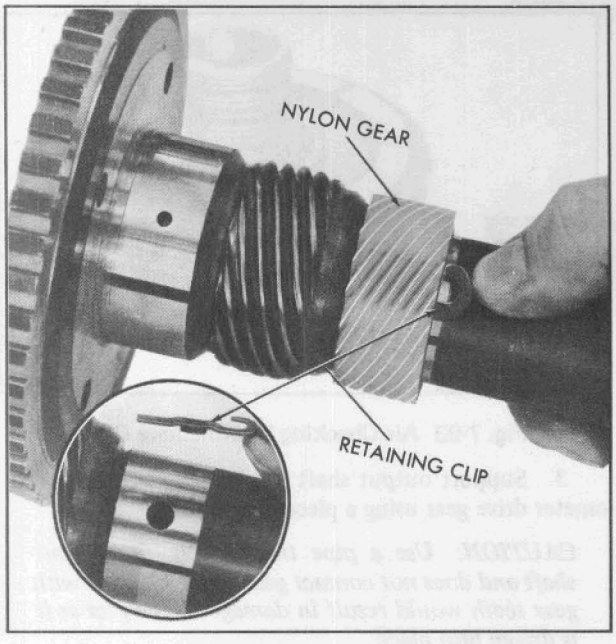


Fig. 7-95 Removing Nylon Speedometer Drive Gear

2. Inspect splines for damage.
3. Inspect ground bushing journals for damage.
4. Inspect snap ring groove for damage.
5. Make sure lubrication holes are open.

Inspection of Rear Internal Gear

1. Inspect gear teeth and bearing surfaces for damage or wear.
2. Inspect splines for damage.
3. Inspect gear for cracks.

Inspection of Output Carrier Assembly

1. Inspect front internal gear for damaged teeth.
2. Inspect pinion gears for damage, rough bearings or excessive tilt.
3. Check pinion end play. Pinion end play should be .009 inch-.024 inch, Fig. 7-98.
4. Inspect parking gear lugs for cracks or damage.
5. Inspect output shaft locating splines for damage.
6. Inspect front internal gear ring for flaking or cracks.

Inspection of Reaction Carrier Assembly

1. Inspect band surface on reaction carrier for signs of burning or scoring.
2. Inspect roller clutch outer cam for scoring or wear.
3. Inspect thrust washer surfaces for signs of scoring or wear.
4. Inspect bushing for damage. If bushing is damaged, carrier must be replaced.
5. Inspect pinion gears for damage, rough bearings or excessive tilt.
6. Check pinion end play. Pinion end play should be .009 inch-.024 inch.

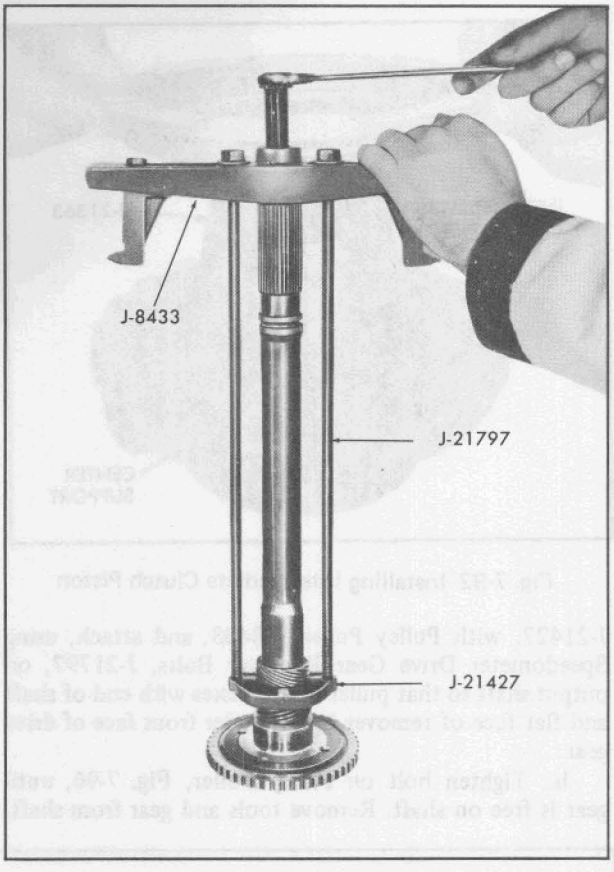


Fig. 7-96 Removing Steel Speedometer Drive Gear

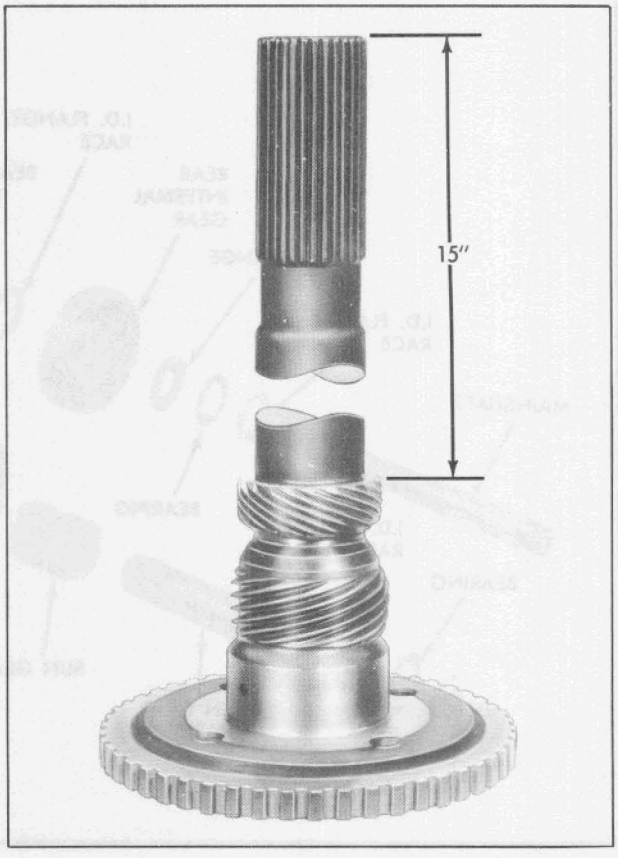


Fig. 7-97 Installing Steel Speedometer Drive Gear

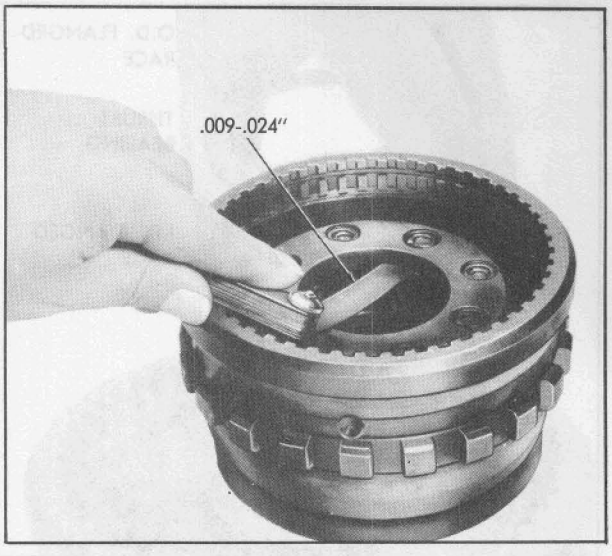


Fig. 7-98 Checking Output Carrier Pinion End Play

Pinion Gear Replacement—Reaction and Output Carrier Assemblies

1. Support carrier assembly on its FRONT face.
2. Using a 1/2 inch diameter drill, remove stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the possibility of cracking the carrier when pinion pins are pressed out.

CAUTION: Do not allow drill to remove any stock from the carrier as this will weaken the part and could cause failure.

3. Using a tapered punch, drive or press pinion pins out of carrier.
4. Remove pinion gears, thrust washers, and roller needle bearings.
5. Inspect pinion pocket thrust faces for burrs and remove if present.
6. Install eighteen needle bearings into each pinion gear using petrolatum to hold bearings in place. Use a pinion pin as a guide.
7. Place a bronze and steel thrust washer on each side of pinion gear with steel washers against gear, Fig. 7-99. Hold washers in place with petrolatum.
8. Place pinion gear assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.
9. Drive a new pinion pin into place from the front, while rotating pinion gear. Be sure that headed end is flush or below face of carrier.
10. Using a punch and bench vise for an anvil, stake opposite end of pinion pin in three places with a blunt radius chisel, Fig. 7-100.

CAUTION: Both ends of pinion pins must lie below face of carrier or interference may occur.

11. Repeat installation procedure for each pinion gear.

Inspection of Roller Clutch Assembly

1. Inspect roller clutch for damaged rollers or springs.
2. Inspect roller clutch cage for damage.

Inspection of Sun Gear

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Be sure oil lubrication hole is open.

Inspection of Sun Gear Shaft

1. Inspect shaft for cracks or splits.
2. Inspect splines for damage.

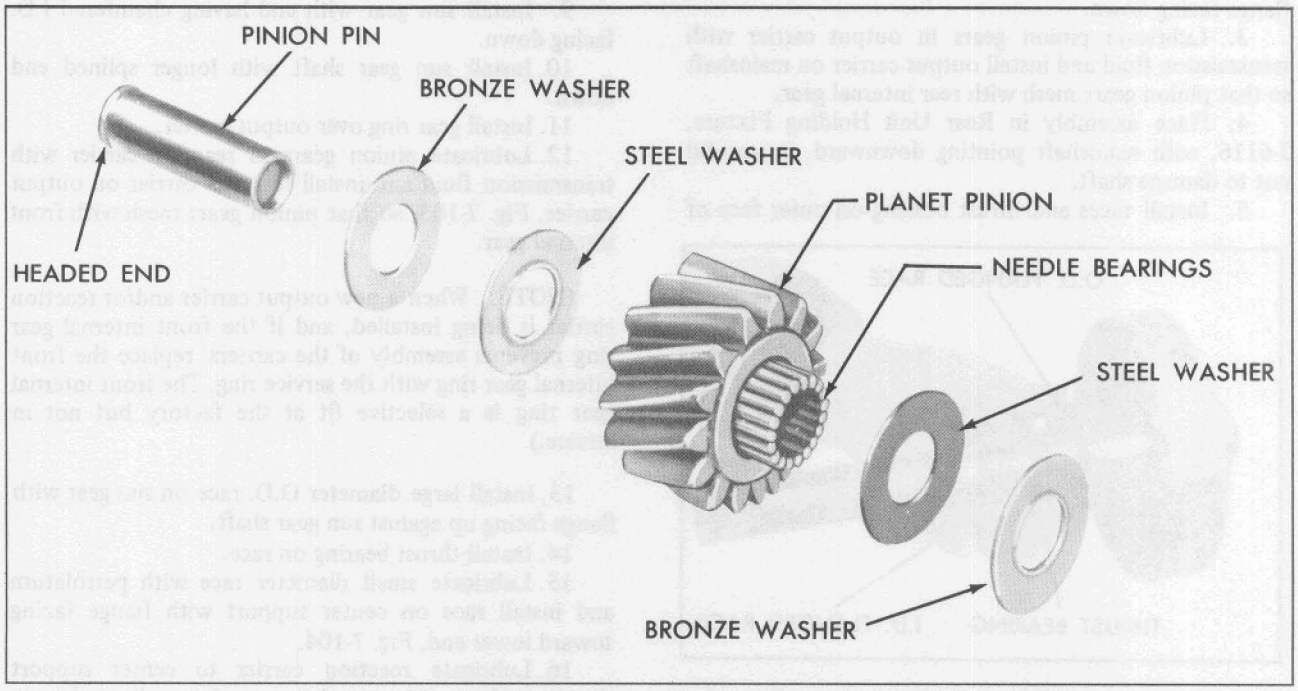


Fig. 7-99 Planet Pinion - Exploded View

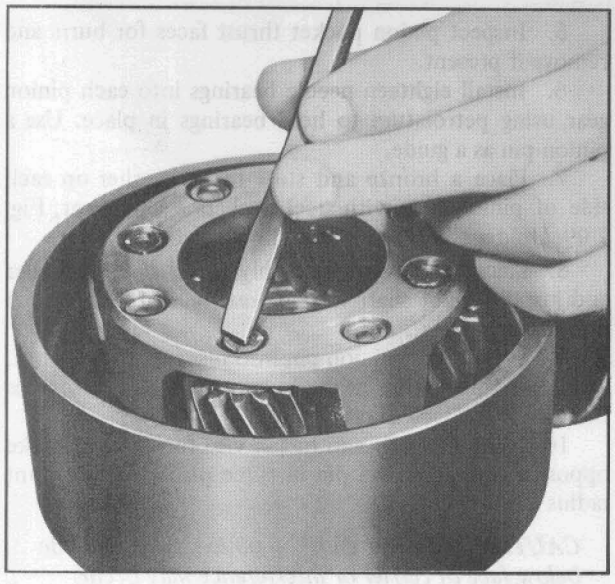


Fig. 7-100 Staking Pinion Nut

3. Inspect bushings for scoring or galling.
4. Inspect ground bushing journals for damage.
5. Be sure oil lubrication hole is open.

Assembly of Complete Gear Unit

1. Install rear internal gear on end of mainshaft that has snap ring groove and install snap ring.

2. Install races and thrust bearing on inner face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

a. Install large diameter race first, with flange facing up, Fig. 7-101.

b. Install thrust bearing in race.

c. Install small diameter race on bearing with inner flange facing down.

3. Lubricate pinion gears in output carrier with transmission fluid and install output carrier on mainshaft so that pinion gears mesh with rear internal gear.

4. Place assembly in Rear Unit Holding Fixture, J-6116, with mainshaft pointing downward. Be careful not to damage shaft.

5. Install races and thrust bearing on outer face of rear internal gear, retaining faces and bearing with petrolatum. Proceed as follows:

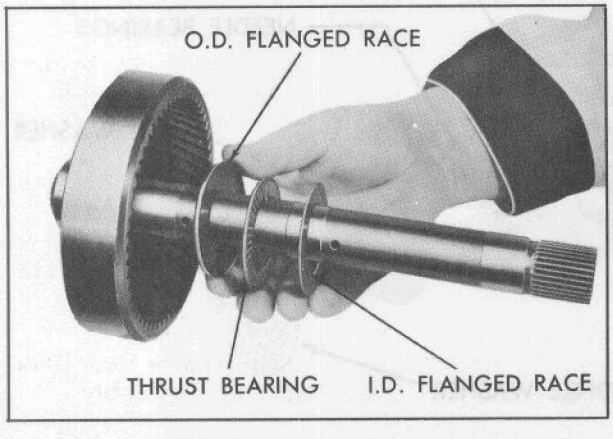


Fig. 7-101 Installing Thrust Bearing on Inner Face of Rear Internal Gear

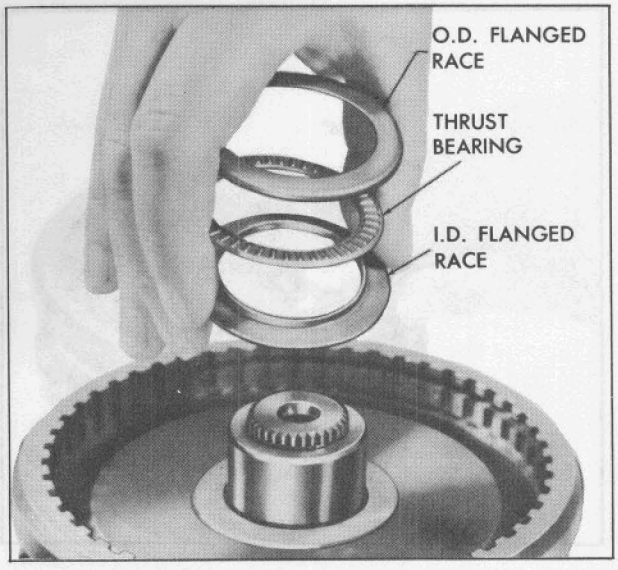


Fig. 7-102 Install Thrust Bearing on Outer Face of Rear Internal Gear

a. Install small diameter (flanged I.D.) race first, with flange facing up, Fig. 7-102.

b. Install thrust bearing in race.

c. Install large diameter (flanged O.D.) race on bearing with flange cupped over bearing.

6. Install output shaft into output carrier and install snap ring. Install new O-ring on output shaft.

7. Invert assembly in Holding Fixture with output shaft pointing downward.

8. Lubricate tab side of reaction-to-output carrier thrust washer with petrolatum and install thrust washer in output carrier with tabs in tab pockets.

9. Install sun gear with end having chamfered I.D. facing down.

10. Install sun gear shaft with longer splined end down.

11. Install gear ring over output carrier.

12. Lubricate pinion gears in reaction carrier with transmission fluid and install reaction carrier on output carrier, Fig. 7-103, so that pinion gears mesh with front internal gear.

(NOTE: When a new output carrier and/or reaction carrier is being installed, and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the service ring. The front internal gear ring is a selective fit at the factory but not in service.)

13, Install large diameter O.D. race on sun gear with flange facing up against sun gear shaft.

14. Install thrust bearing on race.

15. Lubricate small diameter race with petrolatum and install race on center support with flange facing toward lower end, Fig. 7-104.

16. Lubricate reaction carrier to center support thrust washer with petrolatum and install washer in recess in center support.



Fig. 7-103 Installing Reaction Carrier on Output Carrier

17. Install rollers that may have come out of roller clutch cage, by compressing energizing spring with forefinger and inserting roller from outer side, Fig. 7-105.

(NOTE: Make certain that energizing springs are not distorted, and that curved end leaf of springs are positioned aginst rollers.)

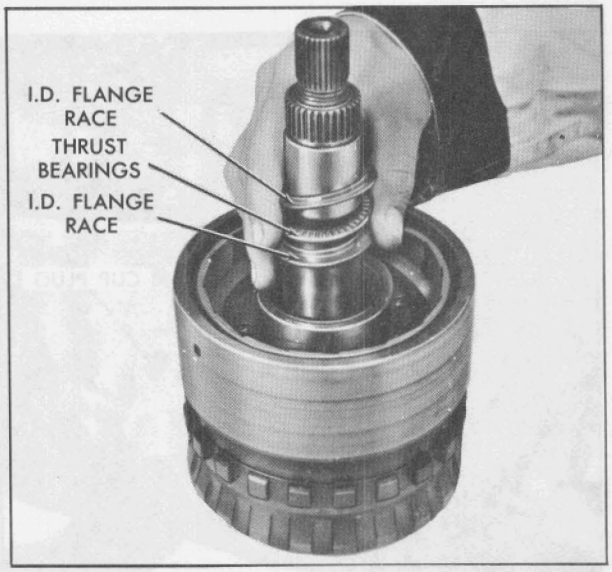


Fig. 7-104 Installing Center Support Thrust Bearing at Sun Gear

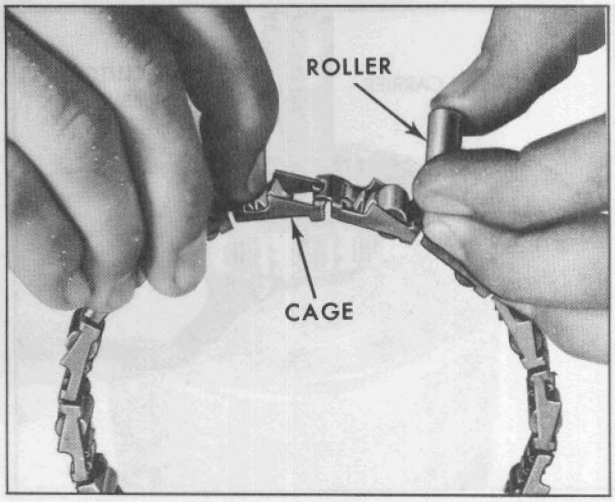


Fig. 7-105 Installing Roller in Roller Clutch Cage

18. Install roller clutch assembly in reaction carrier, Fig. 7-106.

19. Install center support assembly into roller clutch in reaction carrier, Fig. 7-107.

(NOTE: Be sure that center support to reaction carrier thrust washer is in place before installing center support assembly into roller clutch in reaction carrier.)

(NOTE: With reaction carrier held, center support should turn counterclockwise only.)

20. Install Tool J-21365, on end of main shaft so that tangs engage groove in shaft. Tighten screw on tool to secure tool on shaft and prevent movement of the roller clutch during installation of the gear unit assembly.

21. Remove gear unit from Holding Fixture and lay unit on its side. Install thrust washer on rear face of output shaft with bent tabs in tab pockets. Retain thrust washer with petrolatum.

17. Major Transmission Components—Installation

17a. Install Parking Pawl

1. Install parking pawl, tooth toward center of transmission, and install parking pawl shaft, Fig. 7-108.

2. Install parking pawl shaft retainer clip.

3. Install parking pawl shaft cup plug by driving into the transmission case, using a 3/8 inch diameter rod, until the parking pawl shaft bottoms on the case rib, Fig. 7-109.

4. Install parking pawl return spring with square end hooked on pawl.

5. Install parking pawl bracket with guides over parking pawl, Fig. 7-110. Install two attaching screws, tightening screws to 18 foot-pounds.

17b. Install Support to Case Spacer Rear Band and Complete Gear Unit Assembly

1. Inspect rear band for cracks or distortion and band ends for damage at anchor lugs and apply lug. Also inspect lining for cracks, flaking, burning and looseness.

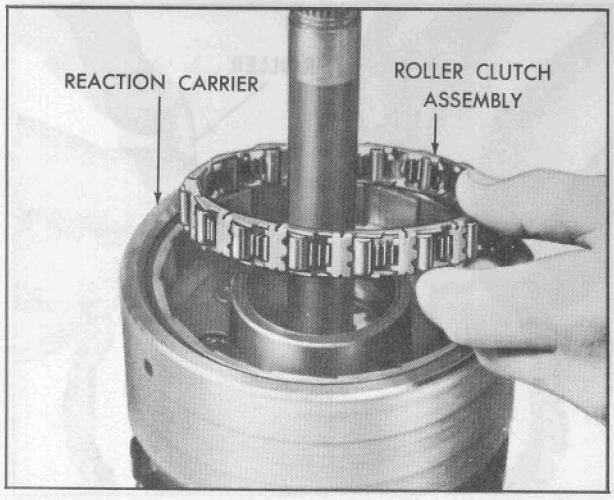


Fig. 7-106 Installing Roller in Reaction Carrier

2. Install rear band assembly in transmission case so that band lugs index with anchor pins, Fig. 7-111.

3. Inspect support to case spacer for burrs or raised edges. If present, remove with a stone or fine sandpaper.

4. Install the support to case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin.

CAUTION: Do not confuse this spacer (.040" thick and both sides flat) with either the center support to case snap ring (one side beveled) or the backing plate to case snap ring (.093" thick and both sides flat), Fig. 7-198.

5. Install previously selected rear unit selective

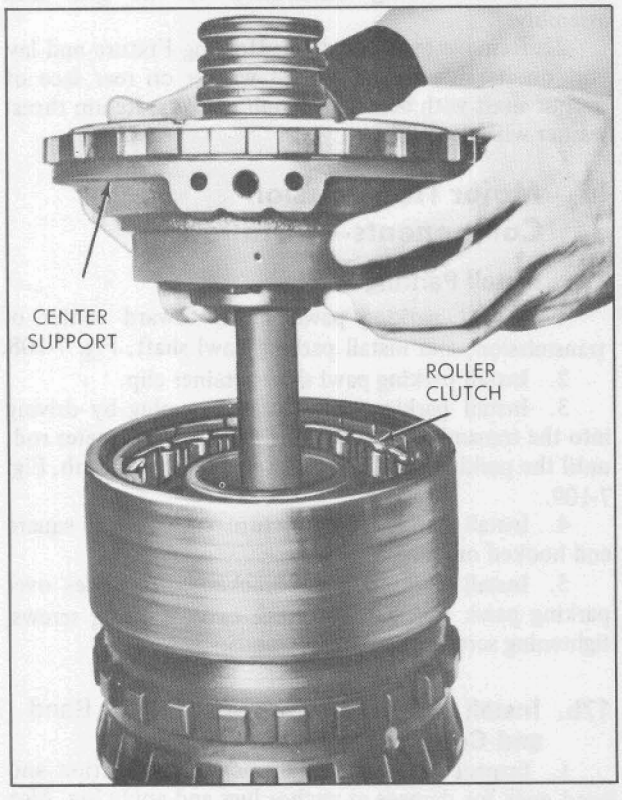


Fig. 7-107 Installing Center Support in Reaction Carrier

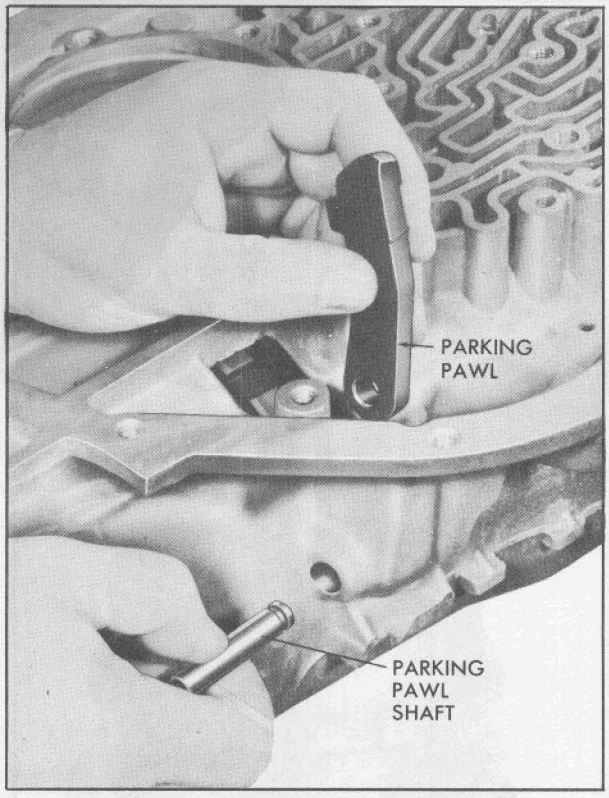


Fig. 7-108 Installing Parking Pawl and Shaft

washer into slots provided inside rear of transmission case. Retain washer with petrolatum.

(NOTE: Proper washer size was determined at time of rear unit end play check Note 15n.)

6. Place transmission case in Holding Fixture in horizontal position. Do not over-tighten transmission Holding Fixture side pivot pin as this will cause binding when gear unit is installed.

7. Install proper diameter length of pipe over output shaft to be used as a handle and to prevent spline

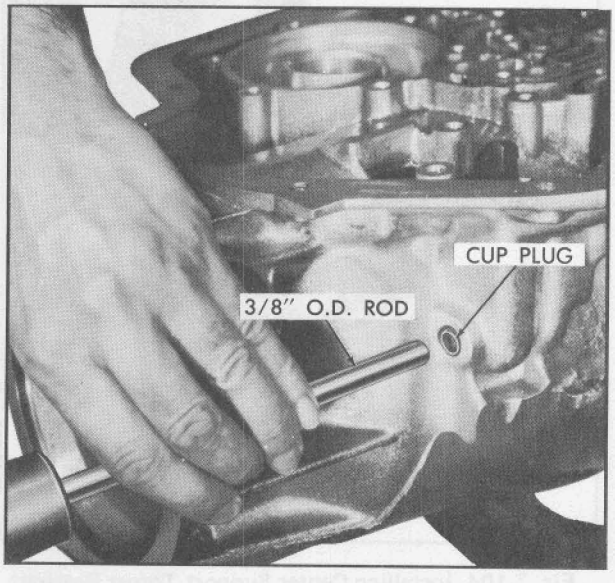


Fig. 7-109 Installing Cup Plug

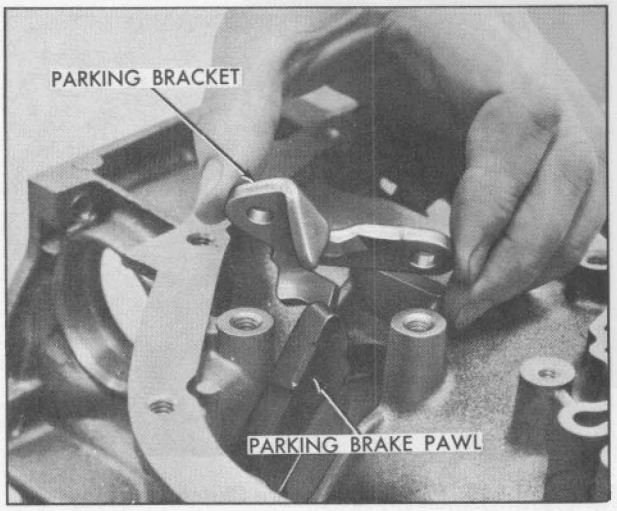


Fig. 7-110 Installing Parking Pawl Bracket

damage to case bushing when installing gear unit assembly.

CAUTION: Be careful not to drop or bump assembly in transmission case during installation. This could result in damage to output shaft case bushing as well as to assembly itself.

8. Install gear unit with center support and reaction carrier, by lining up slots and carefully guiding complete assembly horizontally into transmission case, making certain the center support bolt hole is properly aligned with hole in case.

9. Position transmission vertically with front end of case facing upward. Remove tool, J-21365.

10. Lubricate center support to case snap ring with transmission fluid and install snap ring in transmission case with beveled side up, flat side against center support, locating gap adjacent to front band anchor pin. Expand snap ring until center support is against shoulder of case.

11. Install case to center support bolt.

(NOTE: To correctly perform this operation, it will be necessary to use tool, J-23093 or to make the tool and follow the installation procedure described below.)

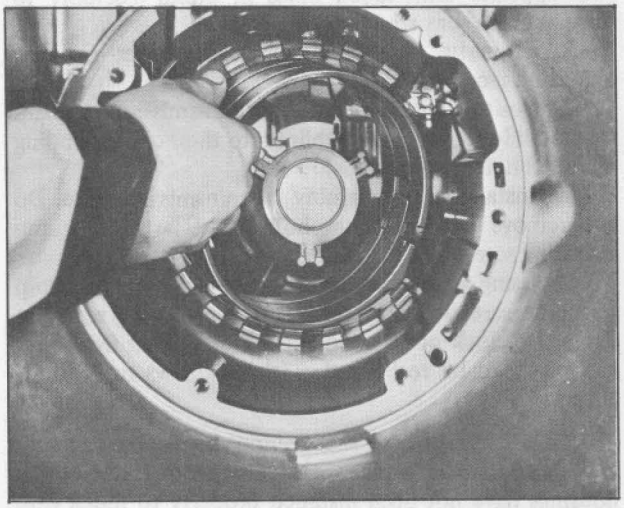


Fig. 7-111 Installing Rear Band Assembly

Make the tool from 3/8" (.375" diameter) cold roll steel or from a screwdriver with a 3/8" diameter shank. The stock should be approximately 12" long. Grind the stock to a blunt point, tapering it 7/8" from the end of the bar to a 1/8" diameter at the end, Fig. 7-112.

Bend the bar to a 45° angle 2-1/2" from the pointed end, Fig. 7-112.

Place the center support locating tool into the direct clutch passage in the case, with the handle of the tool pointing to the right as viewed from the front of the transmission and parallel to the bell housing mounting face.

Apply pressure downward on the tool handle, which will tend to rotate the center support counterclockwise as viewed from the front of the transmission. While holding the center support firmly counterclockwise against the case splines, torque the case-to-center support bolt to 23 ft. lbs. using a 3/8" thin wall deep well socket.

CAUTION: When using the locating tool, take care not to raise burrs on the case valve body mounting face.

12. Before installing intermediate clutch plates, inspect plates for signs of burning, scoring, and wear.

13. Lubricate three steel and three composition intermediate clutch plates with transmission fluid and install clutch plates in transmission case, Fig. 7-113. Start with the waved steel plate and alternate composition and steel plates.

14. Install intermediate clutch backing plate with flat machined surface against clutch plates.

15. Install backing plate to case snap ring with snap ring gap on side of case opposite front band anchor pin.

(NOTE: Both sides of the snap ring are flat and it is approximately .093" thick.)

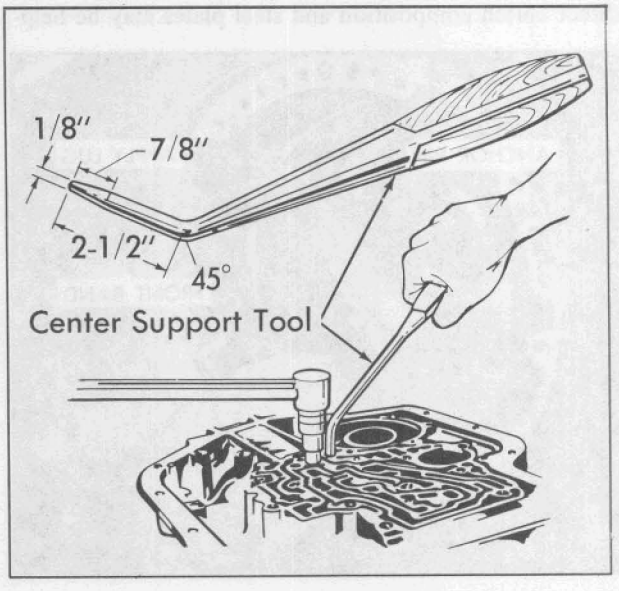


Fig. 7-112 Locating Center Support

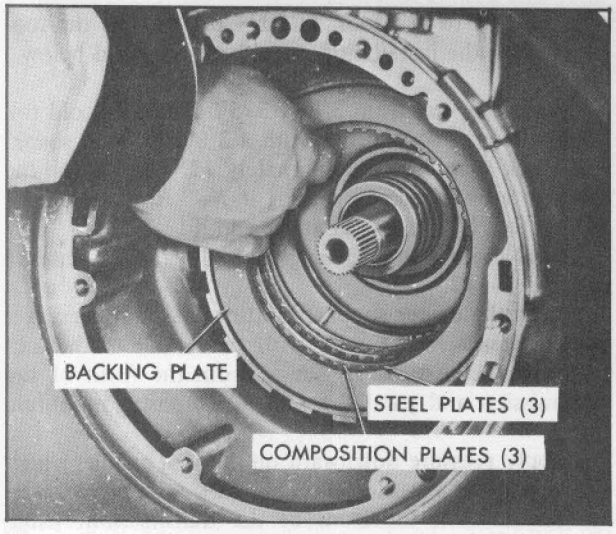


Fig. 7-113 Installing Intermediate Clutch Plates

16. Recheck rear unit end play as described in Note 15n.

17c. Install Front Band and Remaining Clutch Assemblies

1. Inspect front band for cracks or distortion and band ends for damage at anchor lug and apply lug. Also inspect lining for cracks, flaking, burning, and looseness.

2. Install front band with band anchor hole over band anchor pin, and apply lug facing servo hole, Fig. 7-114.

3. Install direct clutch housing and intermediate roller assembly. Make certain that clutch housing hub bottoms on sun gear shaft and splines on forward end of sun gear shaft are flush with splines in direct clutch housing.

(NOTE: It will be necessary to rotate clutch housing to allow roller outer race to index with intermediate clutch composition-faced plates. Removal of direct clutch composition and steel plates may be helpful and applying air pressure through the center support screw to apply the intermediate clutch plates may facilitate assembly.)

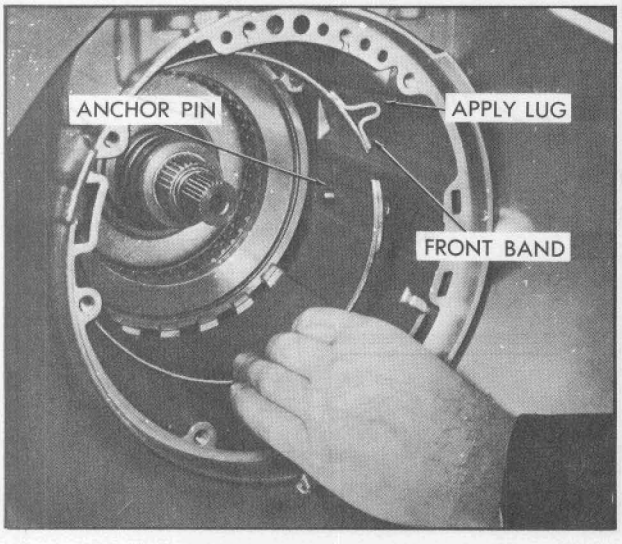


Fig. 7-114 Installing Front Band

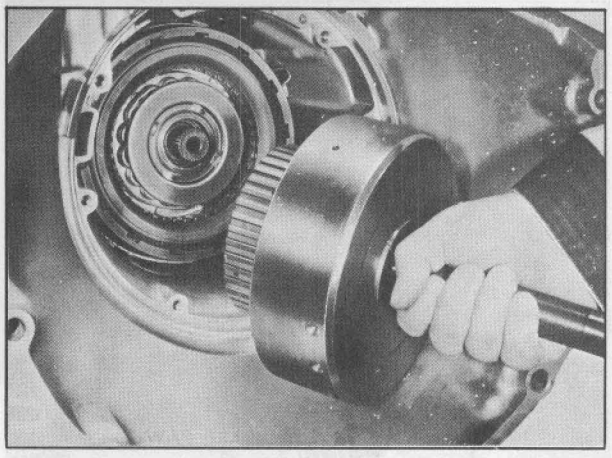


Fig. 7-115 Installing Forward Clutch Assembly

4. Install forward clutch hub to direct clutch housing thrust washer on forward clutch hub. Retain with petrolatum.

5. Position transmission horizontally in Holding Fixture and install forward clutch assembly and turbine shaft, Fig. 7-115. Make certain end of main shaft goes all the way into forward clutch hub. It will be necessary to rotate clutch housing to allow direct clutch driving hub to index with direct clutch composition plates. When forward clutch is seated, it will be approximately 1-1/4 inches from pump mounting face in case.

(NOTE: Missing internal splines in forward clutch hub are lubrication passages and do not have to be indexed with any particular spline on main shaft.)

17d. Install Oil Pump

1. Lubricate turbine shaft journals with transmission fluid and lubricate hook-type oil rings on pump delivery sleeve with petrolatum.

2. Install Slide Hammer Bolts, J-6125-1, through two opposite unthreaded holes in pump assembly to serve as guide pins when installing pump.

3. Properly align pump to case gasket on case mounting face.

4. Position pump assembly in transmission case and thread Slide Hammer assemblies into their corresponding threaded holes in transmission case.

5. Install pump assembly in transmission case. Do not remove slide hammer bolts until last two pump attaching screws are installed.

6. Using eight new rubber-coated washers on pump attaching screws, install all but one attaching screw at either 5 o'clock ot 10 o'clock position so that front unit end play can be rechecked. Tighten screws to 18 foot-pounds.

(NOTE: If turbine shaft cannot be rotated as pump is being pulled into place, the forward or direct clutch housings have not been installed properly to index with all the clutch plates. This condition must be corrected before pump is pulled fully into place.)

7. Recheck front unit end play as described in Note 15j.

8. Install remaining pump attaching screw using new rubber coated washer. Tighten screw to 18 foot-pounds.

9. Apply non-hardening sealer to outside of new seal and install new front seal using Pump Oil Seal Installer, J-21359.

17e. Install Parking Linkage, Detent Lever, and Manual shaft

1. If removed, install a new manual shaft seal into the case using a 3/4 inch diameter rod to seat the seal.

2. Insert actuator rod into manual detent lever from side opposite pin.

3. Install actuator rod plunger under parking bracket and over parking pawl.

4. Install manual shaft assembly into case and through detent lever, Fig. 7-116.

5. Install locknut on manual shaft. Tighten nut to 18 foot-pounds.

6. Install external manual yoke on manual shaft. Tighten nut to 18 foot-pounds.

7. Install retaining pin in case, indexing it with groove in manual shaft, Fig. 7-117.

(NOTE: If procedure is being performed with transmission in car, install and straighten bent pin.)

17f. Install Extension Housing

1. Install new gasket on extension housing, retaining with petrolatum.

2. Check O-ring on output shaft for any nicks or flattening and replace O-ring if either condition exists.

3. Secure extension housing to case with six attaching screws. Tighten screws to 23 foot-pounds.

4. If necessary, install a new extension housing oil seal using Oil Seal Installer, J-21359. Apply non-hardening sealer to outside of seal before installation.

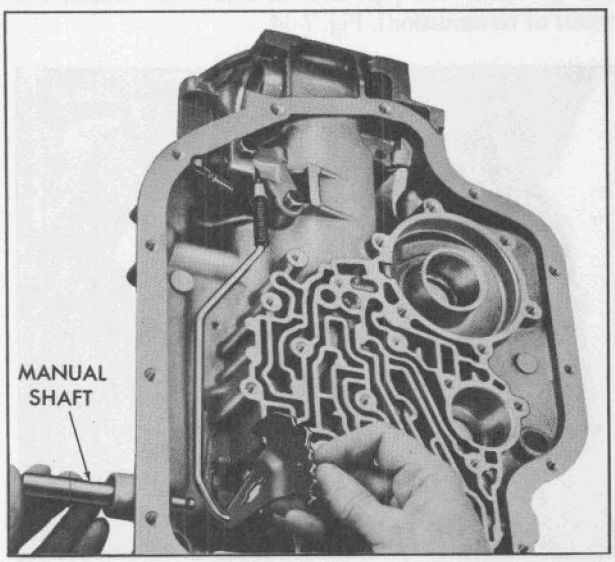


Fig. 7-116 Installing Manual Shaft

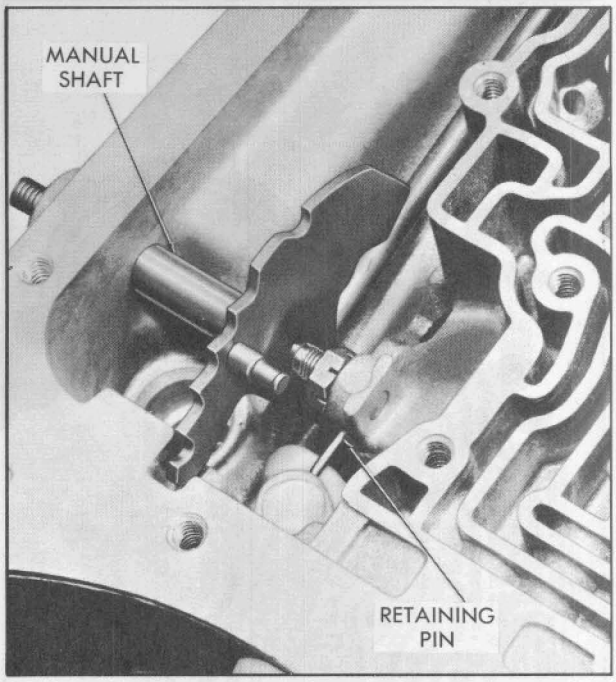


Fig. 7-117 Installing Manual Shaft Retaining Pin

17g. Install Check Balls, Control Valve, Spacer Plate & Gaskets, Detent Solenoid, Front Servo Assembly and Electrical Connector

1. Install two control valve assembly attaching bolts with heads cut off as guide pins as shown in Fig. 7-122.

2. Install six check balls into ball seat pockets in transmission case. Fig. 7-118.

(NOTE: If transmission is in car, install check balls into ball seat pockets on spacer plate, Fig. 7-119.)

3. Install control valve spacer plate.

4. Install detent solenoid gasket.

5. Install detent solenoid assembly with connector facing outer edge of case. Do not tighten bolts at this time.

6. Install front servo spring and spring retainer into transmission case.

7. Install retainer ring in front servo pin groove and install pin into case so that tapered end contacts band. Make certain retainer ring is installed in servo pin groove.

8. Install seal ring on servo piston, if removed, and install on servo pin with flat side of piston positioned toward bottom pan.

(NOTE: The teflon ring allows the front servo piston to slide very freely in the case. The free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.)

(NOTE: If transmission is in car, assemble front servo group as shown in Figure 7-68 and install this group of parts into front servo bore in case and hold. Slip a length of straight, clean feeler gauge or shim stock (about .020") between spacer plate and front servo piston to temporarily retain front servo group.)

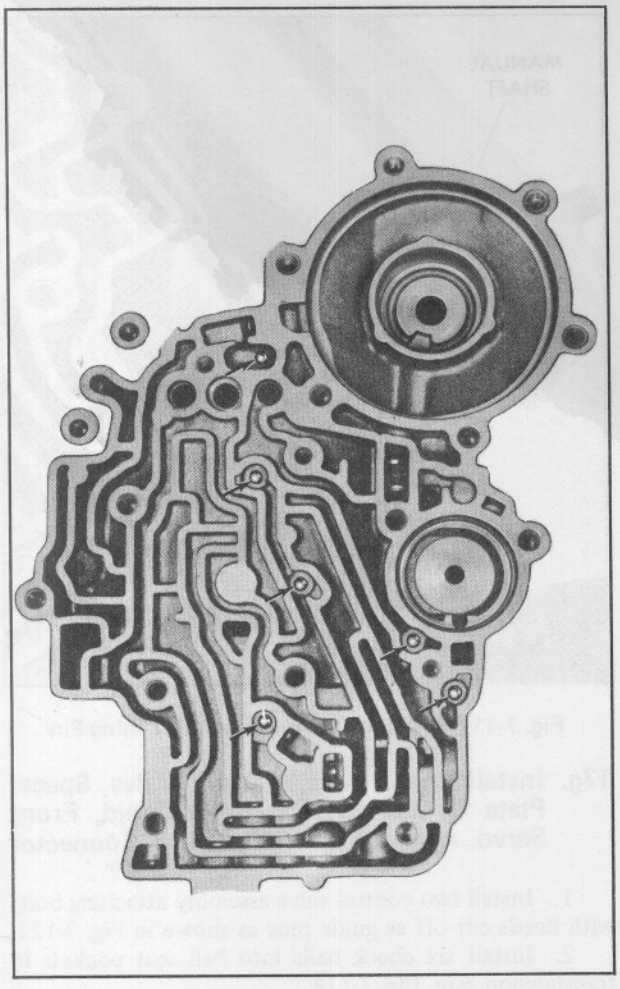


Fig. 7-118 Location of Check Balls

9. Install new O-ring on solenoid connector.

10. Install connector with lock tabs pointing into case. Position locator tab in notch on side of case.

11. Connect detent solenoid wire and lead wire to connector terminals, Fig. 7-121.

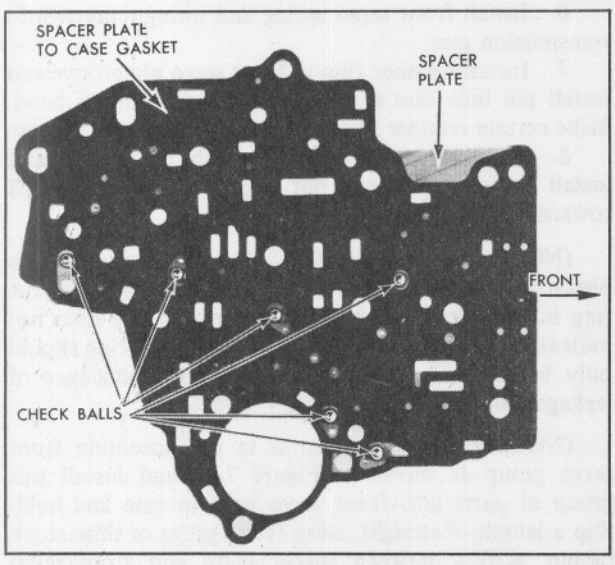


Fig. 7-119 Spacer Plate Gasket with Check Balls

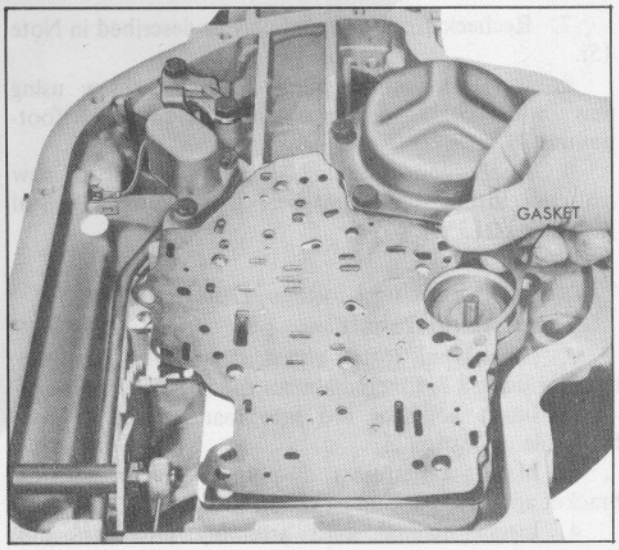


Fig. 7-120 Installing Spacer Gasket

17h. Install Rear Servo Assembly

1. Lubricate inner and outer rear servo bores in transmission case with transmission fluid and install rear accumulator spring in servo inner bore.

(NOTE: Before installing rear servo assembly, make certain that rear band apply lug is aligned with servo pin bore in transmission case. Otherwise servo pin will not apply band.)

2. Position rear servo assembly in transmission.

3. Press down on rear servo assembly, making certain it is properly seated in case bore, and install rear servo cover and new gasket. Install six attaching screws, tightening screws to 18 foot-pounds.

17i. Install Control Valve Assembly, Governor Pipes & Governor Screen Assembly

1. Install governor pipes on control valve assembly. Governor pipes are interchangeable.

2. Install governor screen assembly, open end first; into governor feed pipe hole in case (hole nearest the center of transmission). Fig. 7-44.

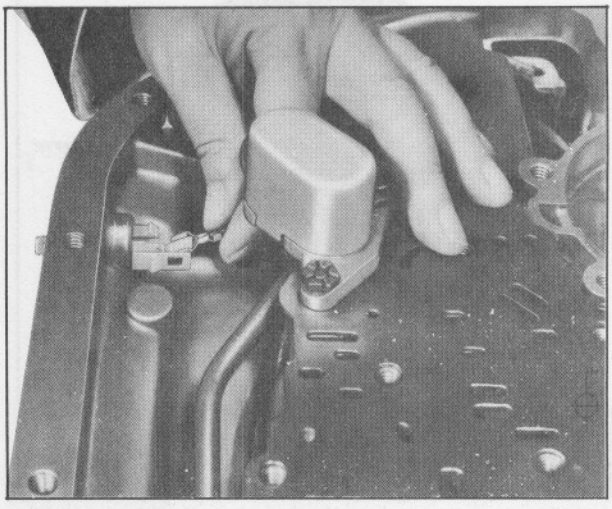


Fig. 7-121 Installing Wires in Electrical Connectors

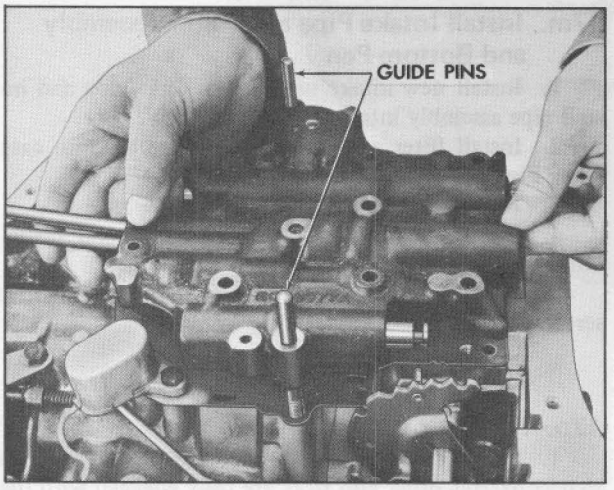


Fig. 7-122 Installing Control Valve

3. Install control valve assembly and governor pipes on transmission, while carefully aligning the governor feed pipe over the governor screen, Fig. 7-122. Make certain gaskets and spacer do not become mispositioned. See Fig. 7-120.

(NOTE: Check manual valve to make sure it is indexed properly with pin on detent lever and governor pipes to make certain they are properly seated in case holes.)

4. Start control valve assembly attaching bolts.

(NOTE: If transmission is in vehicle, remove feeler stock before tightening any control valve bolts.)

5. Remove guide pins and install detent roller and spring assembly and remaining bolts, Fig. 7-123. Torque bolts to 8 ft. lbs.

6. Tighten detent solenoid attaching screws to 10 foot-pounds.

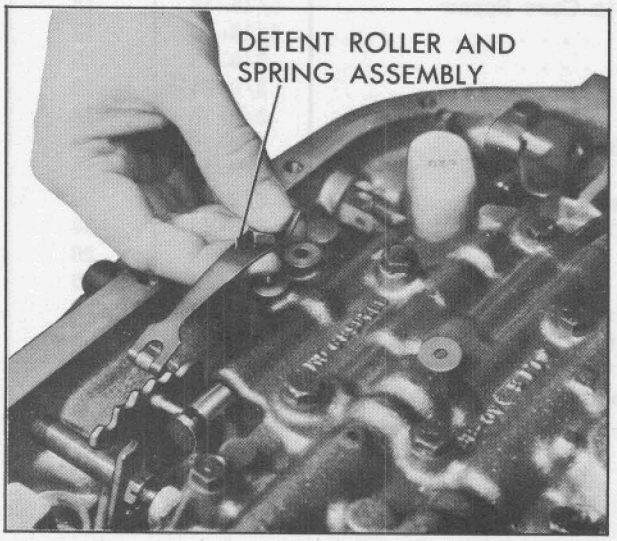


Fig. 7-123 Installing Detent Roller and Spring

17j. Install Modulator Valve and Vacuum Modulator

1. Install modulator valve into case with stem end out.

2. Install new O-ring on vacuum modulator.

3. Install vacuum modulator into case with vacuum hose pipe facing front of car and angled 5° toward top of case.

4. Install modulator retainer with curved side of tangs, inboard and install attaching screw. Tighten screw to 18 foot-pounds.

17k. Install Governor Assembly

1. Install governor assembly into case.

2. Using a new gasket, attach governor cover to case with four attaching screws. Torque screws to 18 foot-pounds.

(NOTE: If transmission is in car proceed as follows.)

3. Install two bolts securing transmission extension housing to cross member.

Series	Rear Axle Ratio	Driven Gear Teeth	Drive Worm Gear Teeth	Sleeve Tooth Range	Color of Driven Gear	Tire Size
681	2.93:1	38	18	36-39	Blue	L-78
682, 683	3.15:1	41	18	40-43	Yellow	
697	3.15:1	40	18	40-43	Black	8.20
698	3.15:1	38	18	36-39	Blue	8.90

17l. Install Speedometer Driven Gear Assembly and Either Speed Controlled Switch or Trackmaster Speed Sensor, Whichever is Applicable

Speedometer driven gears are provided in three different tooth sizes. Driven gear and matching sleeve must be installed to correspond with axle ratio. Refer to chart above to select proper gear.

1. Lubricate driven gear selected from above chart with a small amount of lithum (slip yoke) grease and position driven gear as shown in Fig. 7-124.

2. Install speedometer driven gear retainer with tangs in sleeve positioning bosses, and install attaching screw. Tightening screw to 18 foot-pounds.

CAUTION: Never turn sleeve in transmission case as shaft centerline is eccentric with outside diameter and gear damage will result.

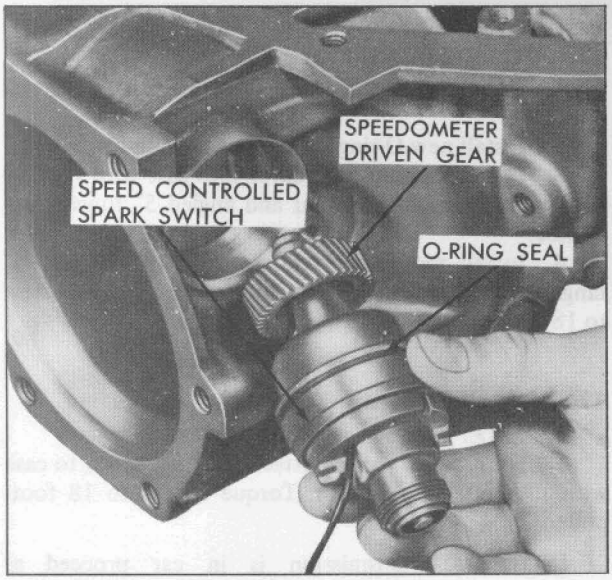


Fig. 7-124 Installing Speedometer Driven Gear

17m. Install Intake Pipe and Filter Assembly and Bottom Pan

1. Install new intake pipe O-ring onto pipe and install pipe assembly into new filter assembly.
2. Install filter and intake pipe assembly into case bore, Fig. 7-42.
3. Install filter retainer bolt, Fig. 7-41.
4. Install new gasket on bottom pan and install bottom pan.
5. Install 13 bottom pan attaching screws. Tighten screws to 12 foot-pounds.

17n. Install Converter

1. Install converter on turbine shaft making certain that converter drive hub slots are fully engaged with the pump drive gear tangs.
2. Install Converter Holding Clamp, J-21366, on front of transmission case, Fig. 7-36.

TORQUE SPECIFICATIONS

Material Number	Application	Thread Size	Foot Pounds
280M	Solenoid to Case Bolt	1/4-20	10
260M	Control Valve Assembly to Case Bolt	1/4-20 5/16-18	8
Special	Line Pressure Plug	1/8 Pipe	10
601M	Lower Cover to Transmission Screw	1/4-20	8
280M	Pump Body to Cover Bolt	5/16-18	18
280M	Pump Assembly to Case Bolt	5/16-18	18
280M	Rear Servo Cover to Case Bolt	5/16-18	18
260M	Governor Cover to Case Bolt	5/16-18	18
280M	Parking Pawl Bracket to Case Bolt	5/16-18	18
260M	Vacuum Modulator Retainer to Case Bolt	5/16-18	18
260M	Speedometer Driven Gear Retainer to Case Screw	5/16-18	18
1010-1020	Bottom Pan to Case Bolt	5/16-18	12
260M	Extension Housing to Case Bolt	3/8-16	23
286M	Manual Shaft to Detent Lever Nut	3/8-24	18
286M	Manual Yoke to Manual Shaft Nut	3/8-16	18
300M	Case to Center Support - Support Bolt	3/8-16	23
300M	Flex-Plate to Converter Bolt	3/8-16	30
280M	Transmission Case to Engine Screw	3/8-16	30
Steel	Oil Cooler Pipe Connector Nut at Case	5/8-18	28
Brass	Cooler Pipe Connector at Case	1/4-18	28
280M	Engine Rear Mount Screw	7/16-14	55
280M	Engine Rear Support Bracket to Frame Bolt	3/8-24	30
286M	Engine Front Cushion to Frame Nut	1/2-20	90

NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings and steel classifications.

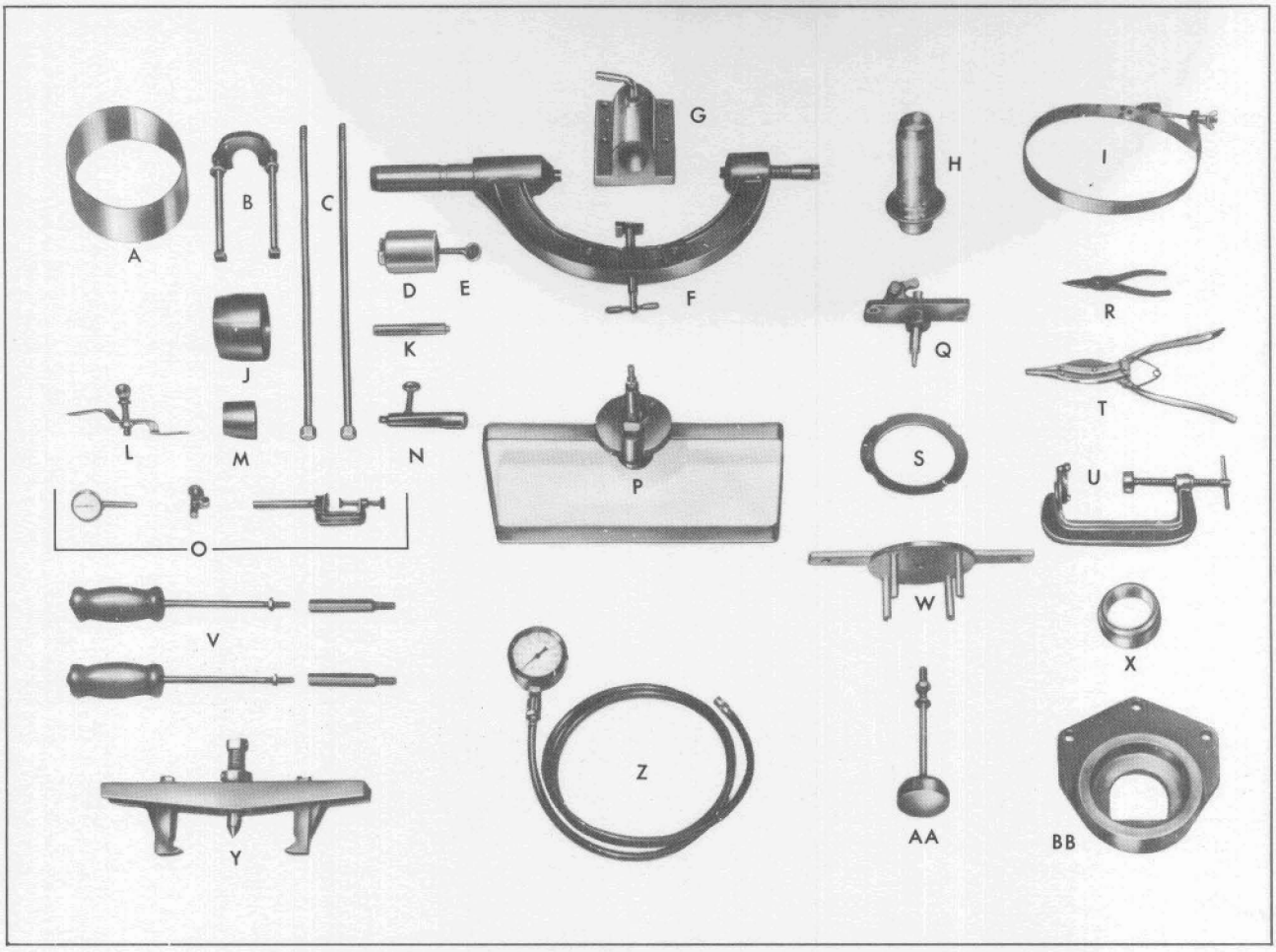


Fig. 7-125 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-21409	Forward and Direct Clutch Piston Installer	M	J-21362	Forward and Direct Clutch Inner Seal Protector
B	J-21427	Speedometer Drive Gear Remover	N	J-21361	Pump Check Valve Seat Remover
C	J-21797	Speedometer Drive Gear Remover Bolts	O	J-8001	Dial Indicator Set
D	J-21795	Gear Assembly Remover and Installer Adapter	P	J-21369	Converter Leak Test Fixture
E	J-21795-4	Thumb Screw	Q	J-21370	Band Apply Pin Selector Gage (Use J-21370-5 Pin)
F	J-8763	Transmission Holding Fixture	R	J-5403	Snap Ring Pliers (#21)
G	J-3289-01	Holding Fixture Base	S	J-21664	Clutch Spring Compressor Adapter
H	J-21359	Pump Oil and Extension Housing Seal Installer	T	J-8059	Snap Ring Pliers
I	J-21368	Pump Body and Cover Alignment Band	U	J-21885	Control Valve Accumulator Piston Installer
J	J-21363	Intermediate Clutch Inner Seal Protector	V	J-6125	Slide Hammer Assemblies
K	J-21360	Pump Check Valve Seat Installer	W	J-4670	Clutch Spring Compressor
L	J-21366	Converter Holding Clamp	X	J-21364	Rear Unit Holding Fixture Adapter
			Y	J-8433	Pulley Puller
			Z	J-5907	0-300 PSI Pressure Gage
			AA	J-6129	Rear Clutch Spring Compressor
			BB	J-6116	Rear Unit Holding Fixture

THEORY OF OPERATION

(NOTE: The following information pertains only to the Eldorado.)

The model AJ Turbo Hydra-matic transmission, Fig. 7-126, used on the Eldorado is a fully automatic transmission used for front wheel drive applications.

The Turbo Hydra-matic transmission consists primarily of a three-element hydraulic torque converter, a dual sprocket and link assembly and a compound planetary gear set. Three multiple-disc clutches, a sprag unit, a roller clutch unit, and two bands provide the friction elements required to obtain the desired functions of the compound planetary gear set.

The torque converter, the dual sprocket and link, the clutches, the sprag and roller clutch, couple the engine to the planetary gears, providing three forward speeds and reverse. The torque converter, when required, will supplement the gears by multiplying engine torque.

The torque converter is of welded construction and is serviced as an assembly. The unit is made up of two

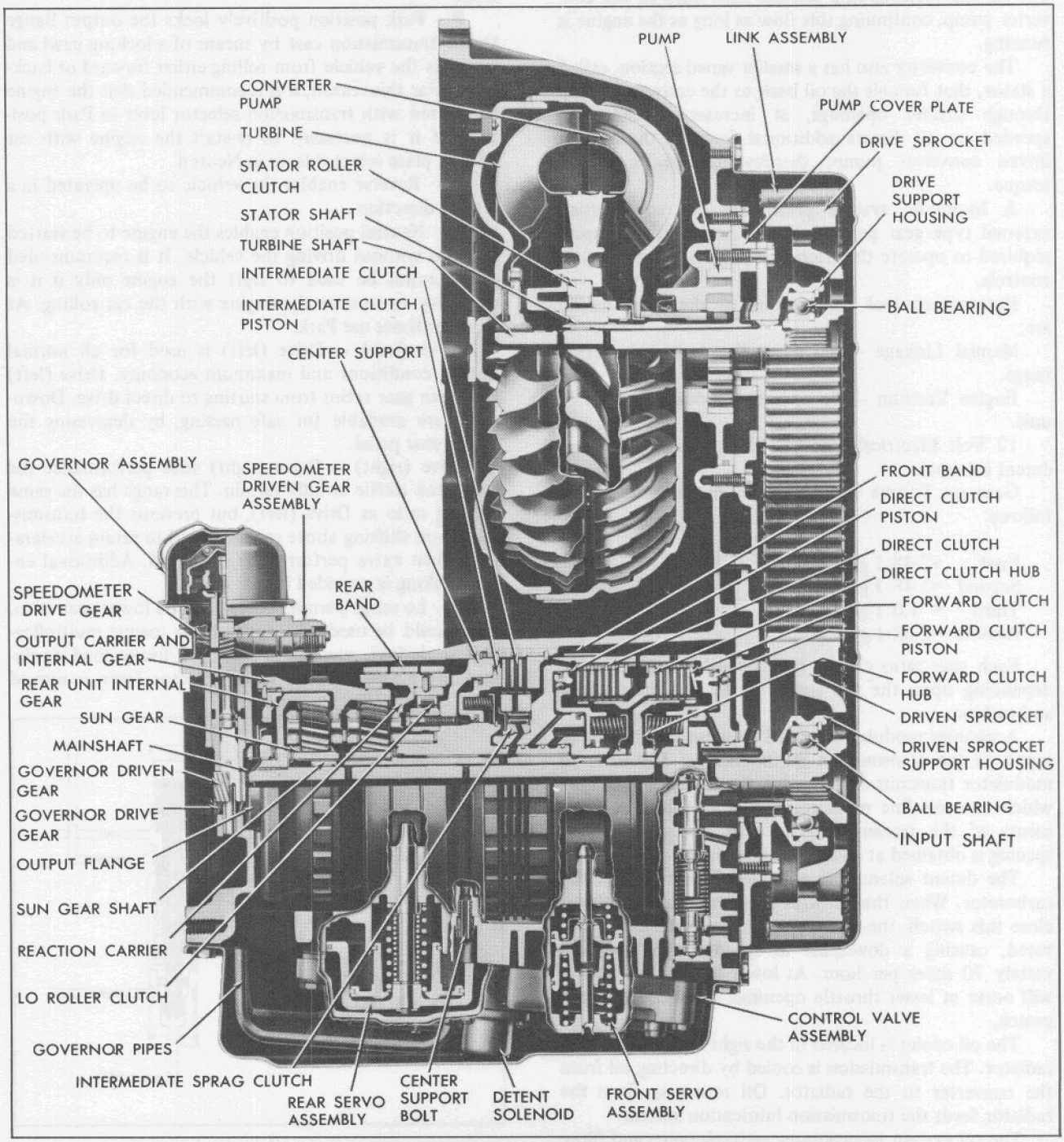


Fig. 7-126 Turbo-Hydramatic Transmission Cutaway

vaned sections, or halves, that face each other in an oil filled housing. The pump half of the converter is connected to the engine and the turbine half is, in effect, connected to the transmission.

The torque converter couples the engine to the planetary gear set through the use of a drive sprocket, a link assembly, and a driven sprocket. Clockwise engine torque turns the drive sprocket clockwise, which, in turn, drives the driven sprocket in a clockwise direction. This in effect is a reverse in the direction of engine torque due to the side mounting of the gear unit.

When the engine makes the converter pump revolve, it sends oil against the turbine, making it revolve also. The oil then returns in a circular flow back to the converter pump, continuing this flow as long as the engine is running.

The converter also has a smaller vaned section, called a stator, that funnels the oil back to the converter pump through smaller openings, at increased speed. The speeded up oil directs additional force to the engine-driven converter pump, thereby multiplying engine torque.

A hydraulic system pressurized by an internal-external type gear pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

Manual Linkage – To select the desired operating range.

Engine Vacuum – To operate a vacuum modulator unit.

12 Volt Electrical Signal – To operate an electrical detent solenoid.

Gear or Torque ratios of the transmission are as follows:

First	=2.48:1 gear ratio
Second	=1.48:1 gear ratio
Third	= 1.0:1 gear ratio
Reverse	=2.08:1 gear ratio

Each gear ratio can be multiplied by as much as 2, depending upon the slip speed of the converter pump and turbine.

A vacuum modulator is used to sense engine torque input to the transmission automatically. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and proper shift spacing is obtained at all throttle openings.

The detent solenoid is activated by a switch at the carburetor. When the throttle is opened sufficiently to close this switch, the solenoid in the transmission is activated, causing a downshift at speeds below approximately 70 miles per hour. At lower speeds, downshifts will occur at lesser throttle openings without use of the switch.

The oil cooler is located in the right hand tank of the radiator. The transmission is cooled by directing oil from the converter to the radiator. Oil returning from the radiator feeds the transmission lubrication system.

The oil system incorporates an intake pipe and filter assembly. The filter assembly should be replaced after the first 24,000 miles. It should be replaced after the first 12,000 miles if heavy duty operation is encountered; such as constant use in heavy metropolitan traffic, pulling trailers, etc. In addition, replace filter assembly when a major transmission failure occurs, and the oil cooler and lines should be flushed. This is particularly important in case of converter failure.

The transmission quadrant has six selector positions that enable the driver to control the operation of the transmission under various driving conditions. The six selector positions appear on the quadrant in the following sequence, from left to right; P-park, R-reverse, N-neutral, DRIVE left, DRIVE right (intermediate) and L-lo.

P – Park position positively locks the output flange to the transmission case by means of a locking pawl and prevents the vehicle from rolling either forward or backward. For this reason, it is recommended that the engine be started with transmission selector lever in Park position. If it is necessary to re-start the engine with car rolling, place selector lever in Neutral.

R – Reverse enables the vehicle to be operated in a reverse direction.

N – Neutral position enables the engine to be started and run without driving the vehicle. It is recommended that Neutral be used to start the engine only if it is necessary to re-start the engine with the car rolling. At all other times use Park.

Drive (left) – Drive (left) is used for all normal driving conditions and maximum economy. Drive (left) has three gear ratios from starting to direct drive. Downshifts are available for safe passing, by depressing the accelerator pedal.

Drive (right) – Drive (right) adds performance for congested traffic or hilly terrain. This range has the same starting ratio as Drive (left), but prevents the transmission from shifting above second speed to retain acceleration when extra performance is desired. Additional engine braking is provided in this range.

L – Lo range permits operation at a lower gear ratio, and should be used where maximum torque multiplication is desired, such as in pulling a heavy load or descending a steep grade. When selector lever is moved

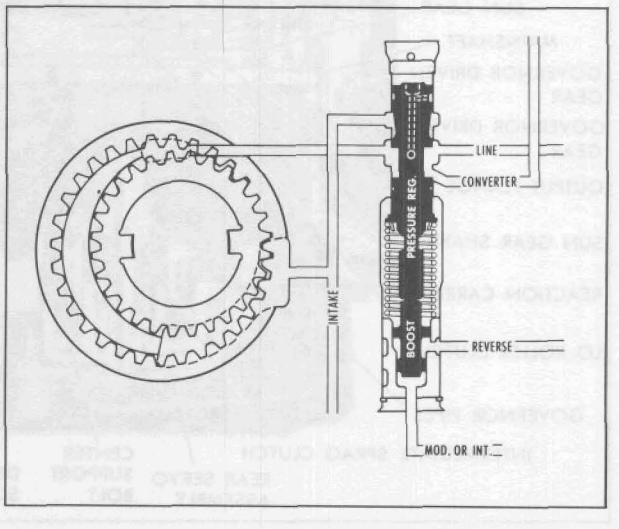


Fig. 7-127 Pressure Control

from Drive to Lo range at normal highway speeds, the transmission will shift to second gear and remain in second gear until vehicle speed is reduced to approximately 45 mph. The transmission will then shift to first gear and remain in first gear regardless of vehicle or engine speed, until selector lever is moved back into either of the Drive positions.

Pressure Control

The transmission is controlled automatically by a hydraulic system, Fig. 7-127. Hydraulic pressure is supplied by the transmission oil pump, which is engine driven. Main line pressure is controlled by a pressure regulator valve train located in the transmission case and by the vacuum modulator which is connected to engine vacuum. The pressure regulator controls line pressure automatically, in response to a pressure signal from a modulator valve in such a way that the torque requirements of the transmission clutches are met and proper shift spacing is obtained at all throttle openings.

HYDRAULIC SYSTEM DESCRIPTION

To control line pressure properly, modulator pressure is used which varies in the same manner as torque input to the transmission. Since the torque input to the clutches is the product of engine torque and converter ratio, modulator pressure must compensate for changes in either or both of these.

To meet these requirements, modulator pressure is regulated by engine vacuum, which is an indicator of engine torque and carburetor opening. It will decrease with an increase in vehicle speed to compensate for the changing converter torque ratio, by virtue of the governor pressure influence.

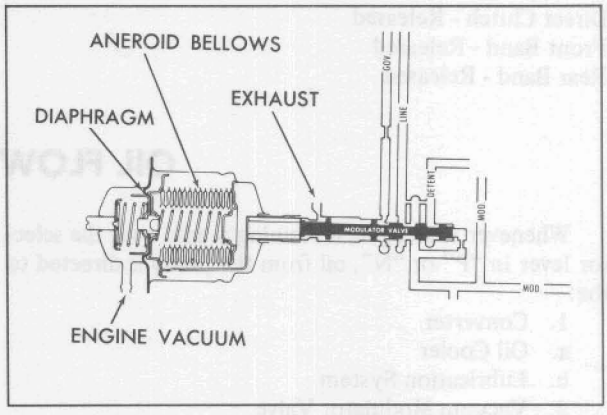


Fig. 7-128 Vacuum Modulator Assembly

Vacuum Modulator Assembly

The engine vacuum signal is received by the vacuum modulator, Fig. 7-128, which consists of an evacuated metal bellows, a diaphragm and a spring. These are so arranged that the bellows and spring apply a force that acts on the modulator valve so that it increases modulator pressure.

Engine vacuum and the enclosed spring oppose the bellows and spring to control modulator pressure.

To reduce the effect of altitude on shift points, the effective area of the diaphragm is different than that of the bellows. Atmospheric pressure acts on the resulting differential area to reduce modulator pressure.

Governor Assembly

The vehicle speed signal to the transmission is supplied by the governor, which is driven by the output flange. The governor consists of flyweights and a regulator valve. Centrifugal force of the flyweights is imposed on the regulator valve, causing it to regulate a pressure signal that increases with speed.

Governor pressure acts on the modulator valve to cause modulator pressure to decrease as vehicle speed increases.

Functions of Valves and Hydraulic Control Units

The valves in the Turbo Hydra-matic transmission used on the Cadillac Eldorado function and are located identically to their corresponding valves in the regular Turbo Hydra-matic transmission with the following exceptions:

1. The pressure regulator valve is located in the transmission case. The valve functions as a regulator for line pressure. The bottom pan must be removed to service this valve located in the right rear corner of the case valve body mounting pad.

2. The modulator valve has a case to valve bushing in which it operates.

3. The governor is mounted with a clip, an external stamped housing, and a square cut O-ring seal.

PARK OR NEUTRAL—ENGINE RUNNING POWER FLOW

Forward Clutch - Released
Roller Clutch - Ineffective
Direct Clutch - Released
Front Band - Released
Rear Band - Released
Intermediate Clutch - Released
Intermediate Sprag - Ineffective

In Neutral or Park no bands or clutches are applied, therefore no power is transmitted.

OIL FLOW (Fig. 7-129)

Whenever the engine is running at idle with the selector lever in "P" or "N", oil from the pump is directed to the:

1. Converter
   a. Oil Cooler
   b. Lubrication System
2. Vacuum Modulator Valve
   a. Pressure Regulator Boost Valve
   b. 1-2 Accumulator and Primary Valves
   c. Detent Valve
   d. 3-2 Valve
   e. 2-3 Shift Valve Train
   f. 1-2 Shift Valve Train
3. Manual Valve
4. Detent Solenoid
5. Detent Valve
6. Front Servo Piston (Neutral only)

Cooling and Lubrication

Oil flows from the pump to the pressure regulator valve which regulates pump pressure. When the pump output exceeds the demand of line pressure, oil from the pressure regulator is directed to the converter feed passage to fill the converter. Oil from the converter is directed to the transmission cooler. Oil from the cooler is directed to the transmission lubrication system.

Line pressure acts on the:

1. Manual Valve
2. Detent Valve
3. Detent Solenoid
4. Modulator Valve
5. Front Servo Piston

Line pressure at the modulator valve is regulated to a pressure called modulator oil, which acts on the pressure boost valve, 1-2 accumulator and primary valves, and passes through the detent valve and 3-2 valve to the 1-2 and 2-3 valve trains.

Summary

The converter is filled. All clutches and bands are released. The transmission is in Neutral.

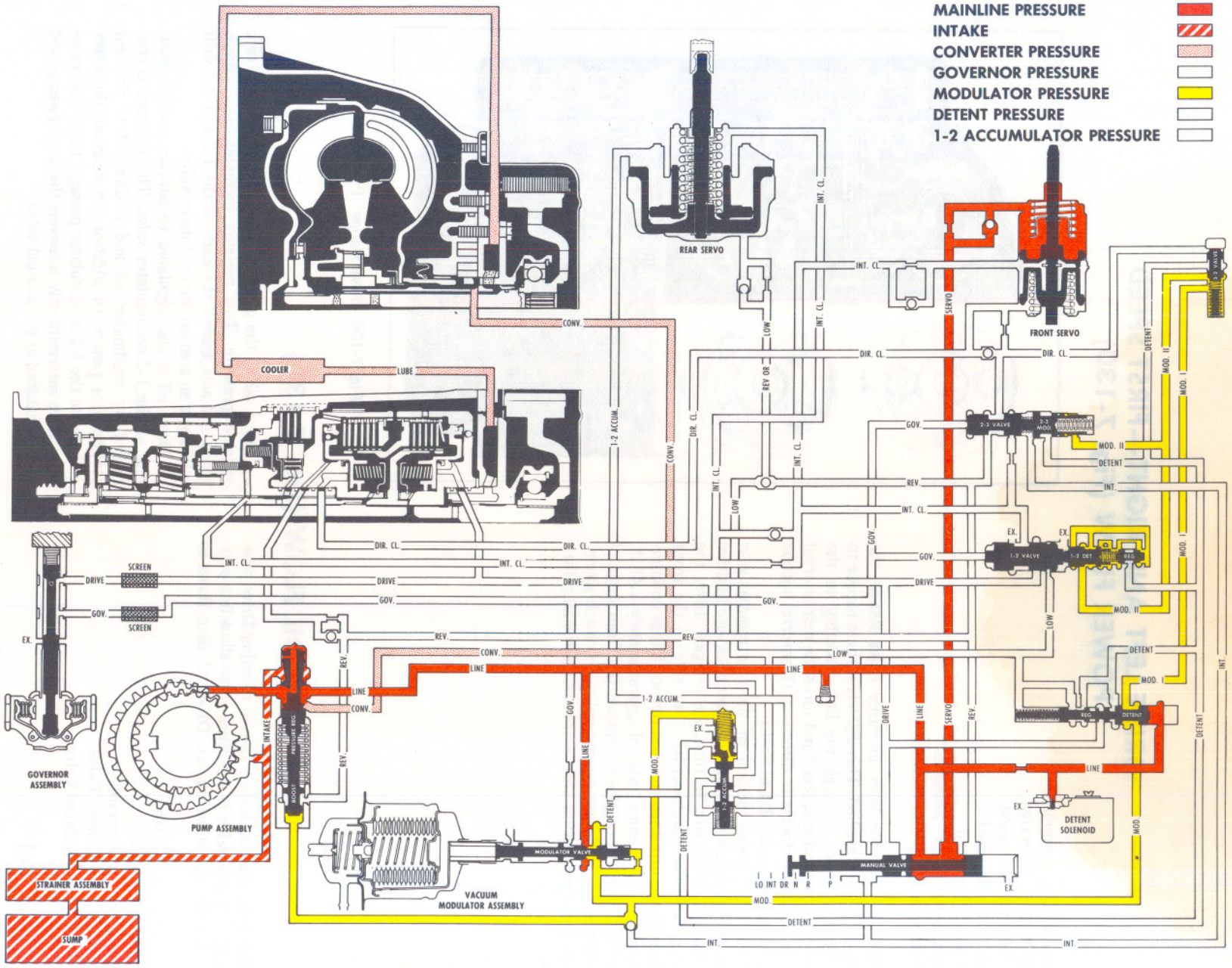


Fig. 7-129 Neutral - Engine Running

DRIVE LEFT AND RIGHT—FIRST SPEED POWER FLOW (Fig. 7-130)

Forward Clutch - Applied
Roller Clutch - Effective
Direct Clutch - Released
Front Band - Released
Rear Band - Released
Intermediate Clutch - Released
Intermediate Sprag - Ineffective

With the selector lever in either Drive Range, the forward clutch is applied. This delivers turbine torque to the drive sprocket, through the link assembly to the driven sprocket and mainshaft and turns the rear internal gear in a counterclockwise direction. (Converter torque ratio = approximately 2:1 at stall.)

Counterclockwise motion of the rear internal gear causes the rear pinions to turn counterclockwise to drive the sun gear clockwise. In turn, the sun gear drives the front pinions counterclockwise, thus turning the front internal gear, output carrier, and output flange counterclockwise in a reduction ratio of approximately 2.48:1. Reaction of the front pinions against the front internal gear is taken by reaction carrier and roller clutch assembly to the transmission case. (Approximate stall ratio - 5:1).

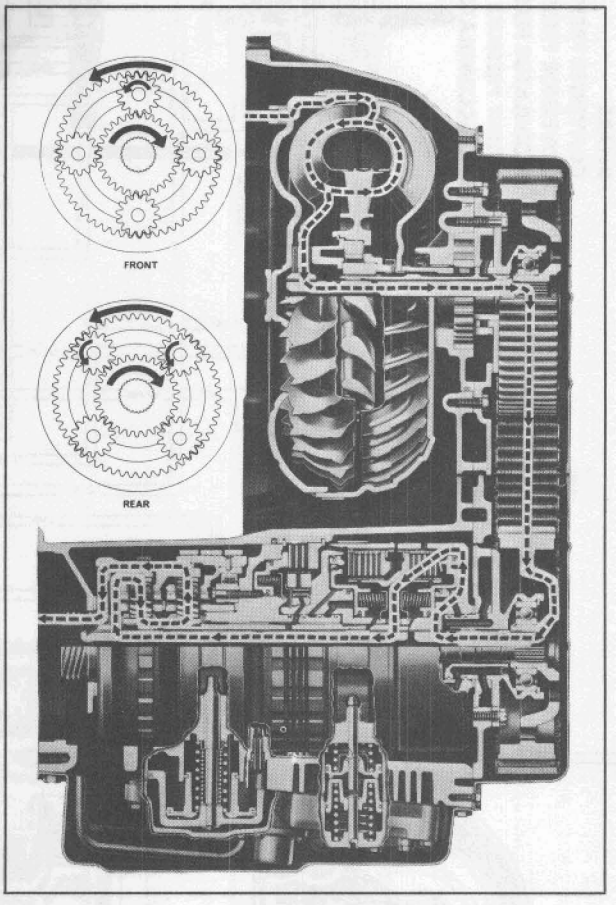


Fig. 7-130 Drive Range - First Gear

OIL FLOW (Fig. 7-131)

When the selector lever is moved to either Drive position, the manual valve is repositioned to allow line pressure to enter the drive circuit. Drive oil then flows to the:

1. Forward Clutch
2. 1-2 Shift Valve
3. Governor Assembly
4. 1-2 Accumulator Valve
5. Detent Regulator Valve

Basic Control

Drive oil is directed to the forward clutch where it acts on two areas of the clutch piston to apply the forward clutch. The first, or inner area, is fed through an unrestricted passage. The outer area is fed through an orifice to insure a smooth shift into Drive.

Drive oil at the governor assembly is regulated to a variable pressure. This pressure increases with vehicle speed and acts against the ends of the 1-2 and 2-3 shift valves and an area on the modulator valve.

Drive oil is also regulated to another variable pressure at the 1-2 accumulator valve. This pressure is controlled by modulator oil and is directed to the rear accumulator piston. In addition, to maintain the lower pressure in the 1-2 accumulator passage, the 1-2 accumulator valve intermittently uncovers the lo oil passage and oil is exhausted at the manual valve.

Summary

The converter is filled. The forward clutch is applied. The transmission is in first gear.

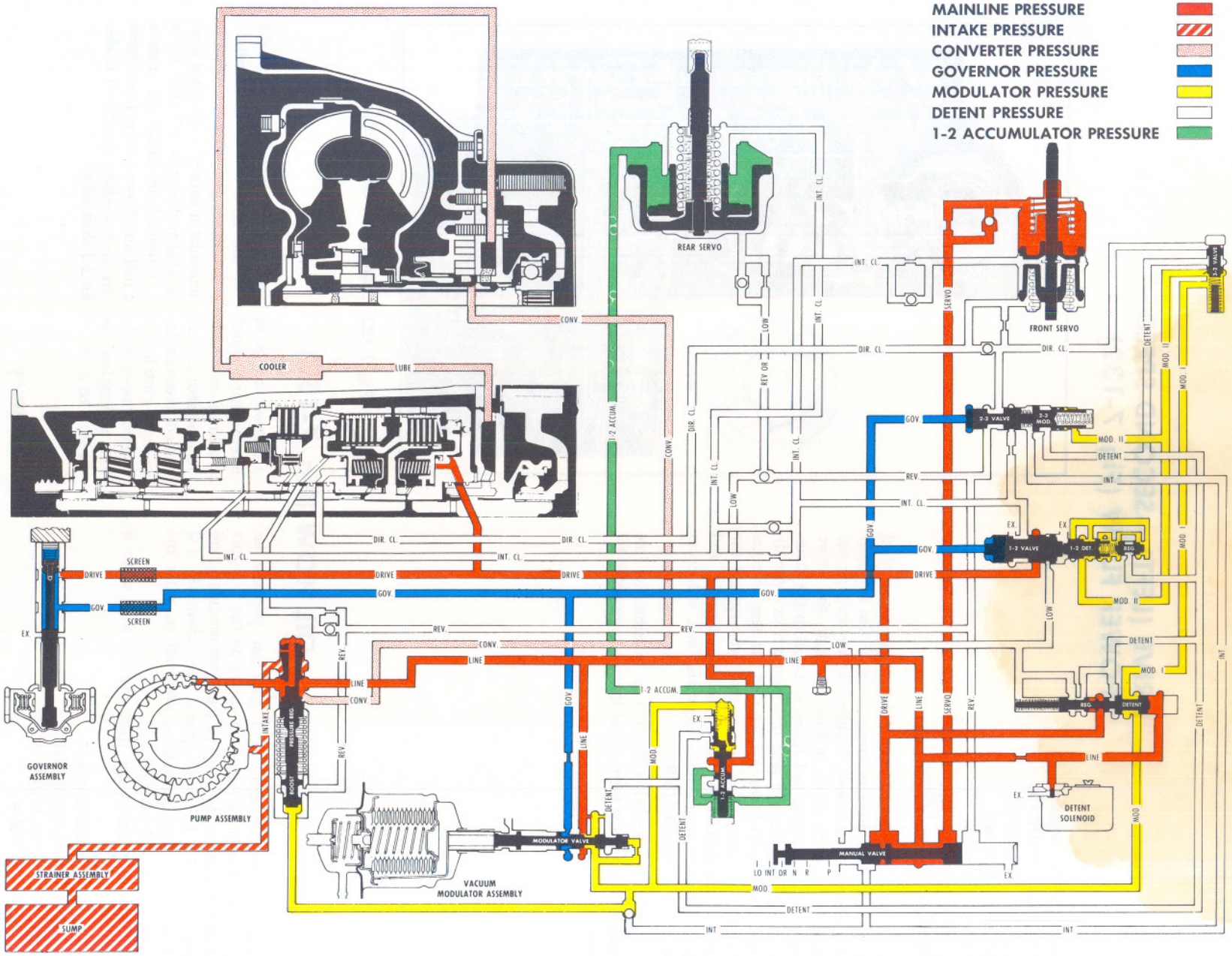


Fig. 7-131 Drive Range - First Gear

DRIVE (LEFT)—SECOND SPEED POWER FLOW (Fig. 7-132)

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Released
Front Band - Released
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Effective

In second speed, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against clockwise rotation. Turbine torque through the forward clutch is now applied through the drive sprocket, link assembly and driven sprocket to the mainshaft to the rear internal gear in a counterclockwise direction. Counterclockwise rotation of the rear internal gear turns the rear pinions counterclockwise against the stationary sun gear. This causes the output carrier and output flange to turn counterclockwise in a reduction ratio of approximately 1.48:1.

NOTE: Further reduction is possible, at low speeds, due to the torque multiplication provided by the converter.

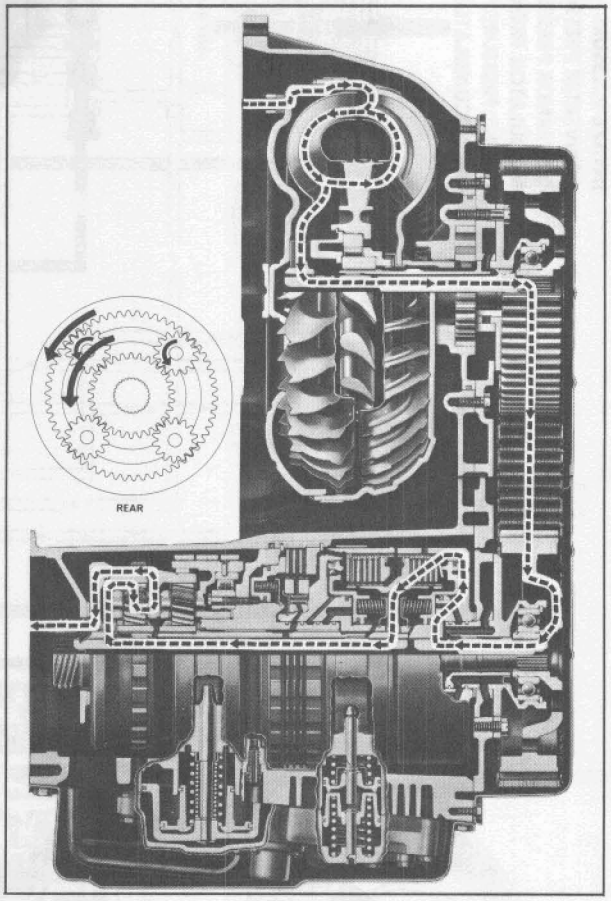


Fig. 7-132 Drive (Left) - Second Gear

OIL FLOW (Fig. 7-133)

As both vehicle speed and governor pressure increase, the force of governor oil acting on the 1-2 shift valve will overcome the force of regulated modulated oil pressure and the 1-2 valve spring. This allows the 1-2 shift valve to open, permitting drive oil to enter the intermediate clutch passage.

Intermediate clutch oil from the 1-2 shift valve is directed to the:

1. Intermediate Clutch
2. Rear Servo Accumulator
3. Front Servo Accumulator
4. 2-3 Shift Valve

Basic Control

Intermediate clutch oil from the 1-2 shift valve seats a one-way check ball and flows through an orifice to the intermediate clutch. At the same time, intermediate clutch oil moves the accumulator piston against the 1-2 accumulator oil and accumulator spring to maintain controlled pressure in the clutch during a 1-2 shift for a smooth clutch apply. Intermediate clutch oil seats a second one-way check ball and flows to the front servo and accumulator pistons. Intermediate clutch oil is also directed to a land of the 2-3 shift valve.

Summary

The forward and intermediate clutches are applied. The transmission is in second speed.

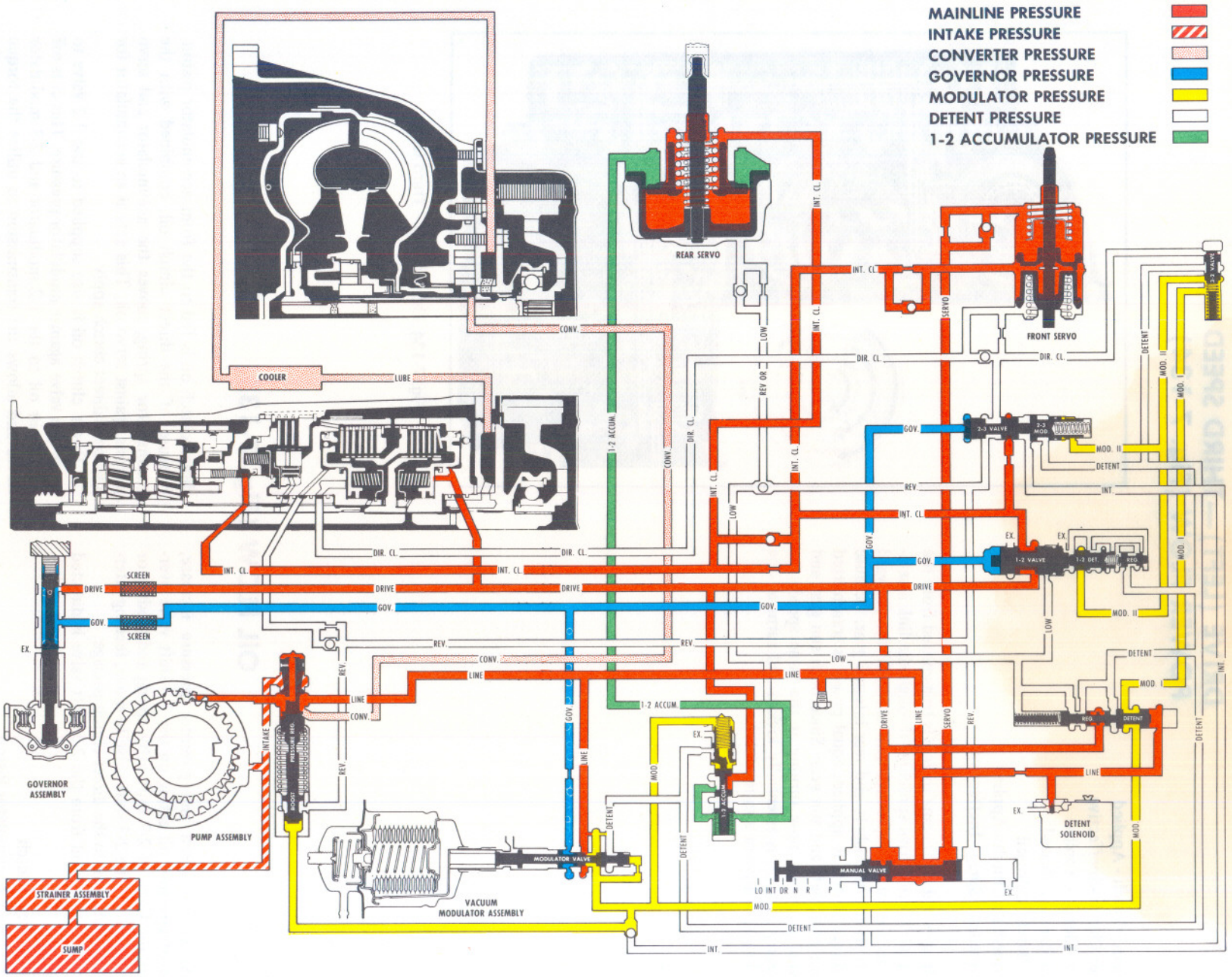


Fig. 7-133 Drive (Left) - Second Gear

DRIVE (LEFT)—THIRD SPEED POWER FLOW (Fig. 7-134)

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Applied
Front Band - Released
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Ineffective

In direct drive, engine torque is transmitted from the converter to the drive sprocket, through the link assembly, to the driven sprocket and through the forward clutch to the mainshaft and rear internal gear. Because the direct clutch is applied, equal power is transmitted to sun gear shaft and sun gear. Since both sun gear and internal gears are now turning at the same speed, the planetary gear set is essentially locked and turns as one unit in direct drive or a ratio of 1:1.

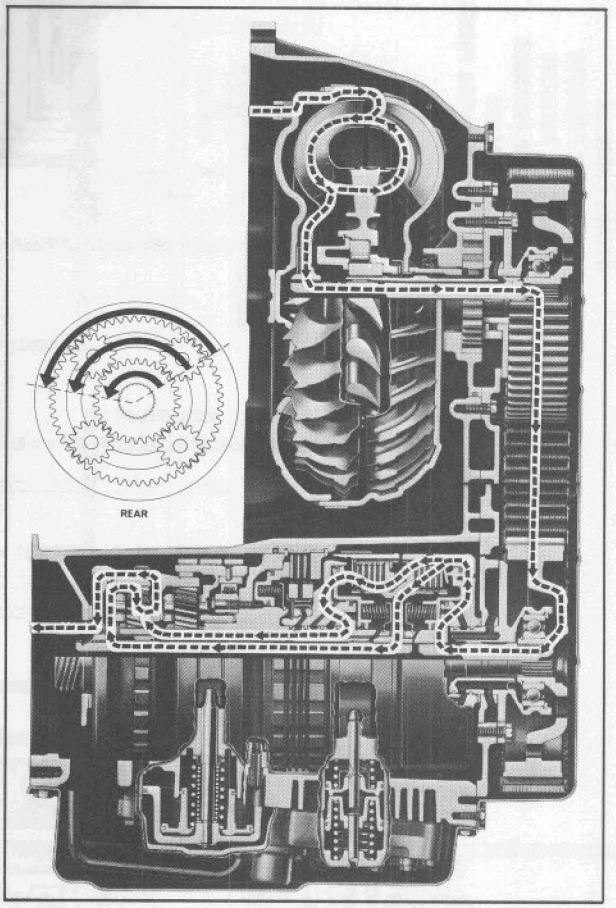


Fig. 7-134 Drive (Left) - Third Gear

OIL FLOW (Fig. 7-135)

As vehicle speed and governor pressure increase, force of governor oil acting on the 2-3 shift valve overcomes the force of 2-3 shift valve spring and modulator oil. This allows the 2-3 shift valve to move, feeding intermediate clutch oil to the direct clutch passage.

Direct clutch oil from the 2-3 shift valve is directed to the:

1. Direct Clutch
2. Front Accumulator Piston
3. 3-2 Valve

Basic Control

Direct clutch oil from the 2-3 shift valve flows past a one-way check valve to the inner area of the direct clutch piston to apply the direct clutch. Simultaneously, direct clutch oil is fed to the front accumulator piston. Pressure of the direct clutch oil, combined with the accumulator spring, moves the accumulator and servo pistons against servo oil. This acts as an accumulator for a smooth direct clutch apply.

Direct clutch oil is also supplied to the 3-2 valve to move the valve against modulator pressure. This cuts off modulator oil to the 1-2 modulator and 2-3 modulator valves and allows the transmission to utilize the torque multiplying characteristics of the converter during medium throttle operation without downshifting.

Summary

The forward, intermediate and direct clutches are applied. The transmission is in third gear (direct drive).

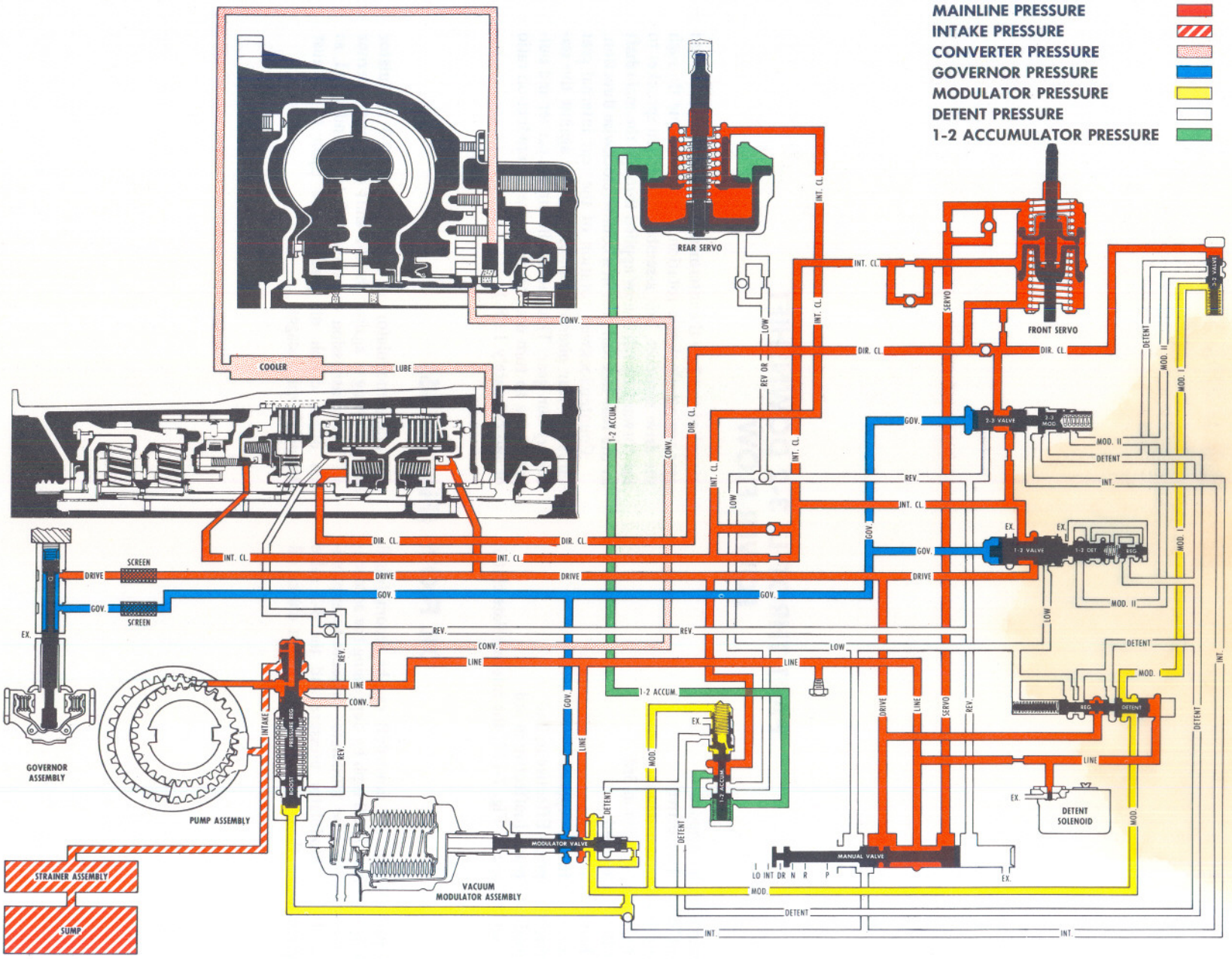


Fig. 7-135 Drive (Left) - Third Gear

PART THROTTLE 3-2 DOWNSHIFT POWER FLOW

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Released in 2nd
Direct Clutch - Applied in 3rd
Front Band - Released
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Effective in 2nd
Intermediate Sprag - Ineffective in 3rd

In second speed, Fig. 7-132, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against clockwise rotation. Turbine torque through the drive sprocket, link assembly and driven sprocket to the forward clutch is now applied through the mainshaft to the rear internal gear in a counterclockwise direction.

Counterclockwise rotation of the rear internal gear turns the rear pinions counterclockwise against the stationary sun gear. This causes the output carrier and output flange to turn counterclockwise in a reduction ratio of approximately 1.48:1.

OIL FLOW (Fig. 7-136)

A part throttle 3-2 downshift can be accomplished below approximately 30 mph by depressing the accelerator far enough to raise modulator pressure to approximately 81 psi. Modulator pressure and the 3-2 valve spring will move the 3-2 valve against direct clutch oil and allow modulator oil to act on the 2-3 modulator valve, moving it against the 2-3 shift valve and governor oil. The transmission will then shift to second speed, as the direct clutch oil passages are open to exhaust through lo-oil passages.

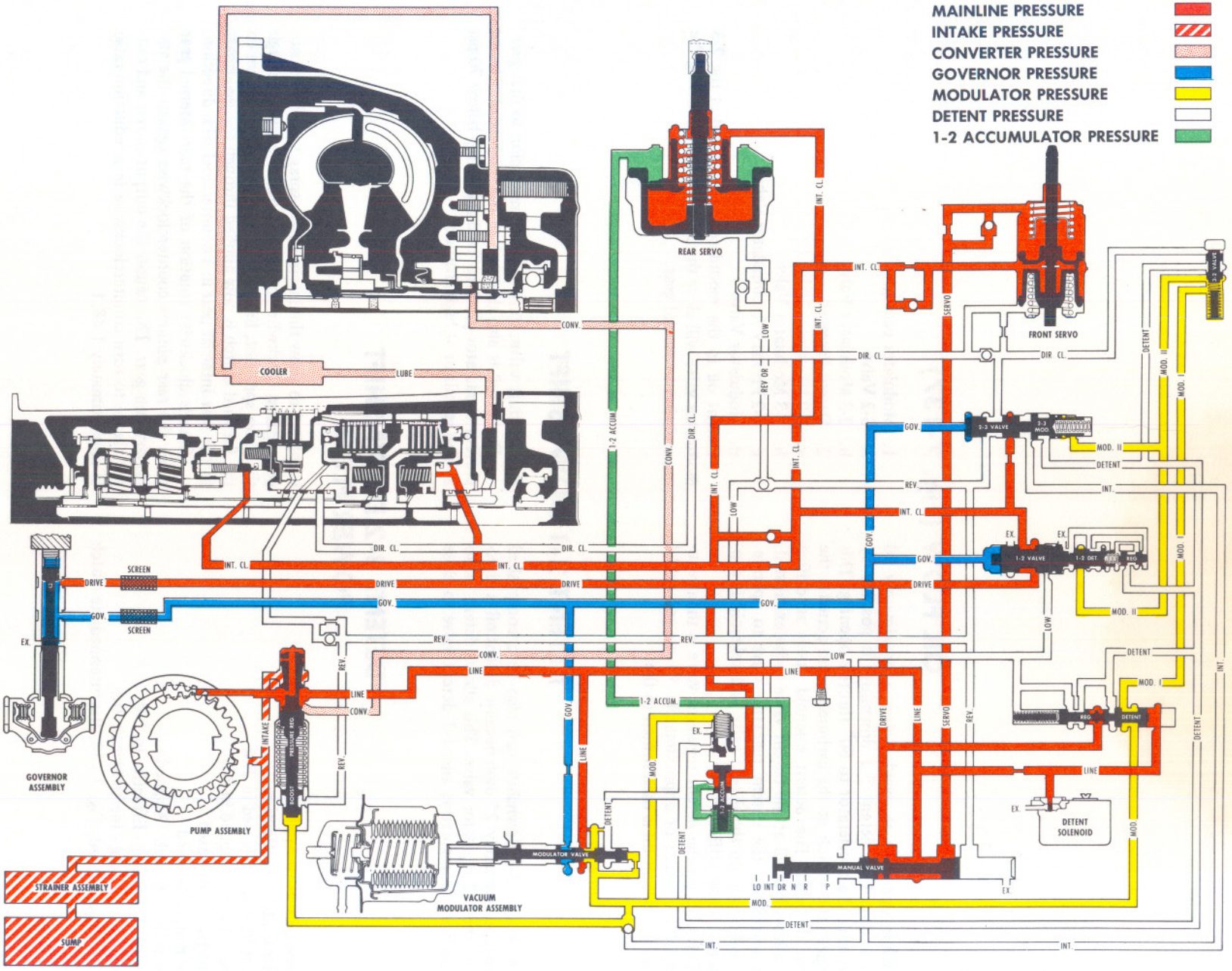


Fig. 7-136 Part Throttle 3-2 Downshift

OIL FLOW (Fig. 7-137)

While operating at speeds below approximately 70 mph a forced or detent 3-2 downshift is possible by depressing the accelerator to 60° throttle opening. This energizes the switch at the carburetor and actuates the detent solenoid. The detent solenoid opens an orifice that allows line oil at the detent valve to be exhausted, thus permitting the detent regulator valve to operate. Line oil acting on the detent valve and solenoid is supplied by a small orifice.

Drive oil on the detent regulator valve is then regulated to a pressure of approximately 70 psi and called detent oil. Detent oil is then routed to the:

1. Modulator passages
   a. 3-2 Valve
   b. 2-3 Modulator Valve
2. Detent Passages
   a. 1-2 Modulator Valve
   b. 2-3 Modulator Valve
   c. 1-2 Primary Accumulator Valve
   d. Modulator Valve

Detent oil in the modulator passage and at the 2-3 modulator valve will close the 2-3 shift valve, shifting the transmission to second gear.

DETENT 2-1 DOWNSHIFT

A detent 2-1 downshift can also be accomplished below approximately 25 mph because detent oil is directed to the 1-2 regulator valve. This allows detent oil to act on the 1-2 regulator, and 1-2 detent valve to close the 1-2 shift valve, shifting the transmission to first gear.

Detent oil is also directed to the modulator valve to prevent modulator pressure from regulating below 70 psi at high speeds or at high altitudes.

DETENT 3-2 DOWNSHIFT POWER FLOW

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Released in 2nd
Direct Clutch - Applied in 3rd
Front Band - Released
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Effective in 2nd
Intermediate Sprag - Ineffective in 3rd

In second speed, Fig. 7-132, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against clockwise rotation. Turbine torque through the drive sprocket, link assembly and driven sprocket to the forward clutch is now applied through the mainshaft to the rear internal gear in a counterclockwise direction.

Counterclockwise rotation of the rear internal gear turns the rear pinions counterclockwise against the stationary sun gear. This causes the output carrier and output flange to turn counterclockwise in a reduction ratio of approximately 1.48:1.

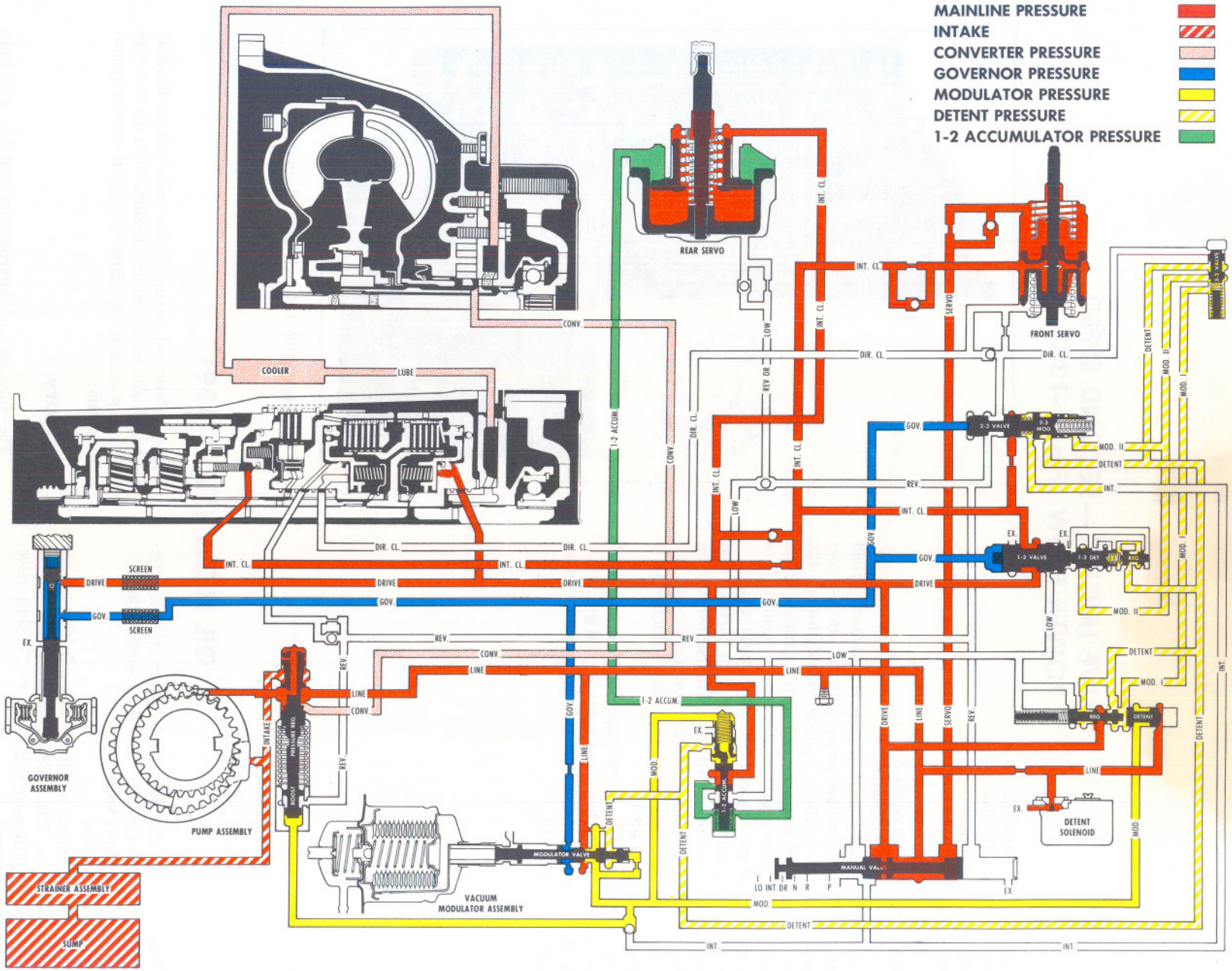


Fig. 7-137 Detent 3-2 Downshift

DRIVE (RIGHT)—SECOND SPEED POWER FLOW (Fig. 7-138)

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Released
Front Band - Applied
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Effective

In second speed, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against clockwise rotation. Turbine torque through the drive sprocket, link assembly and driven sprocket to the forward clutch is now applied through the mainshaft to the rear internal gear in a counterclockwise direction.

Counterclockwise rotation of the rear internal gear turns the rear pinions counterclockwise against the stationary sun gear. This causes the output carrier and output flange to turn counterclockwise in a reduction ratio of approximately 1.48:1.

In second speed - Drive (right), engine braking is provided by the front band as it holds the sun gear fixed. Without the band applied, the sun gear would overrun the intermediate sprag.

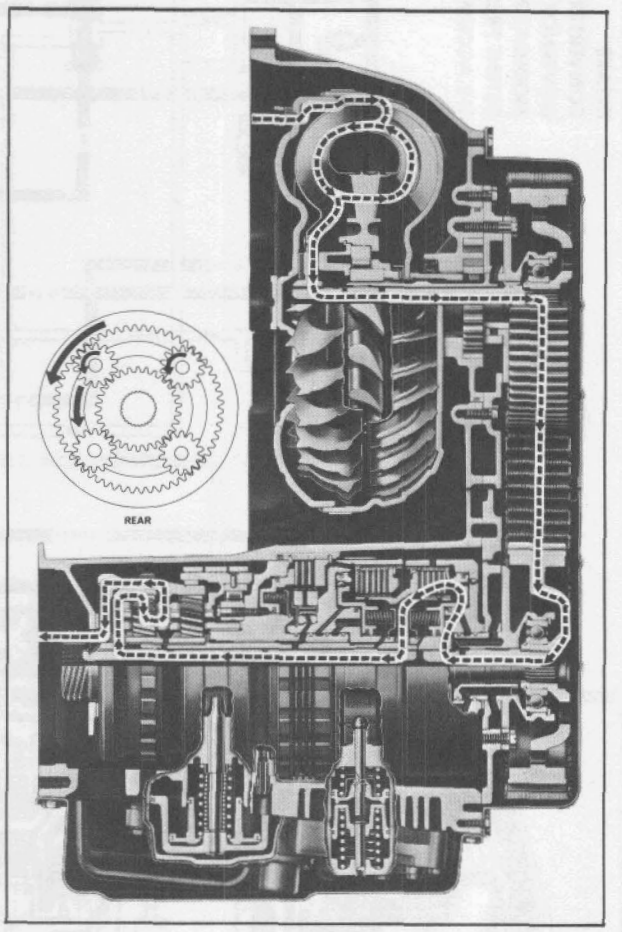


Fig. 7-138 Drive (Right) - Second Gear

OIL FLOW (Fig. 7-139)

When the selector lever is in Drive (right), intermediate oil from the manual valve is directed to the:

1. Pressure Boost Valve
2. 2-3 Shift Valve

Intermediate oil at the boost valve will increase line pressure to 150 psi. This increased intermediate oil pressure at the 2-3 shift valve will close the 2-3 shift valve, regardless of car speed.

For engine braking the front band is applied by exhausting servo oil at the manual valve. This allows intermediate clutch oil, acting on the servo piston, to move the piston and apply the front band. Once the transmission is in second speed - Drive (right), it cannot upshift to third gear.

Summary

The forward and intermediate clutches and front band are applied. The transmission is in second gear - Drive (right).

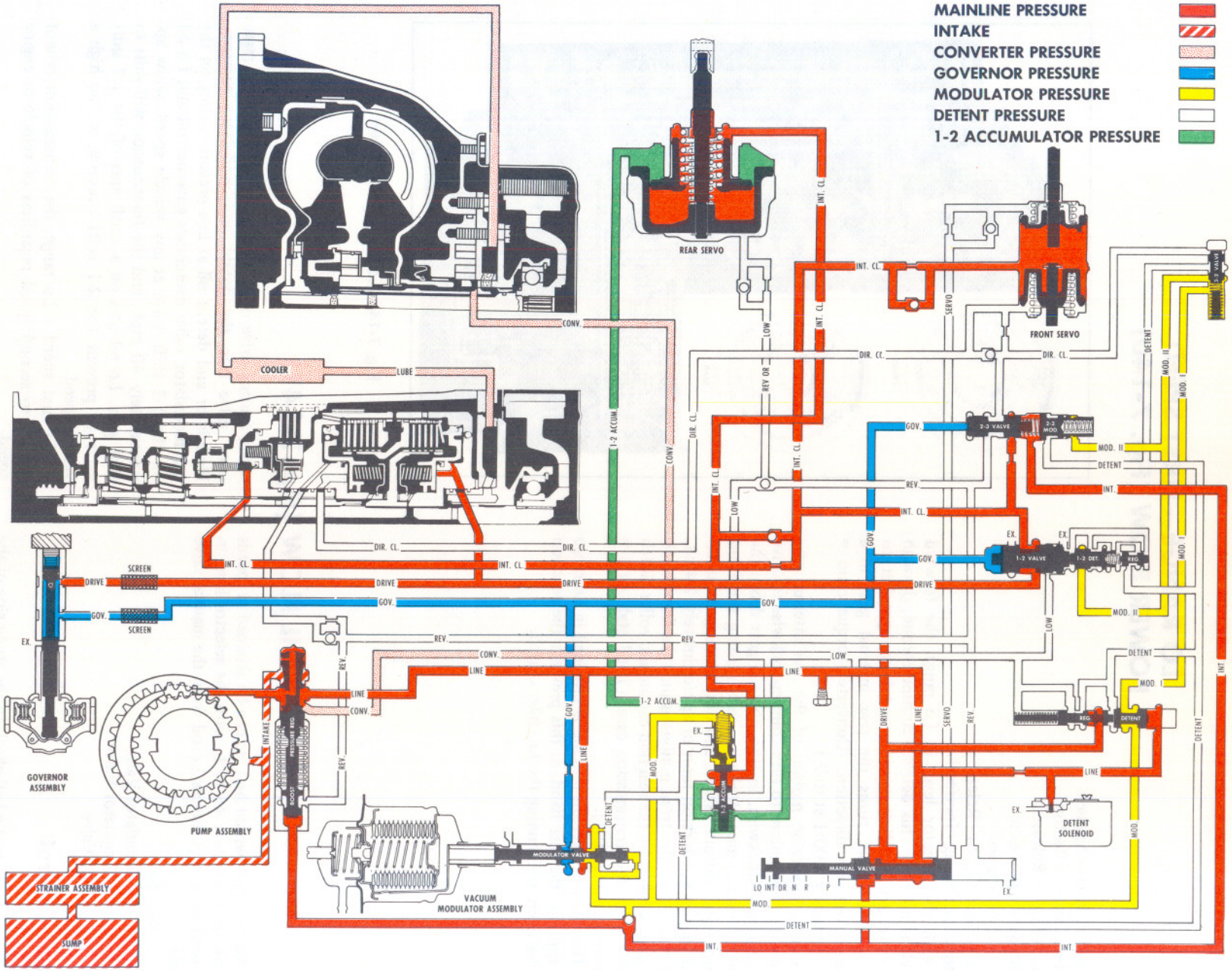


Fig. 7-139 Drive (Right) - Second Gear

LO RANGE—FIRST SPEED POWER FLOW (Fig. 7-140)

Forward Clutch - Applied
Roller Clutch - Effective
Direct Clutch - Released
Front Band - Released
Rear Band - Applied
Intermediate Clutch - Released
Intermediate Sprag - Ineffective

With the selector lever in Lo range, the forward clutch is applied. This delivers turbine torque, through the drive sprocket, link assembly and driven sprocket, to the mainshaft and turns the rear internal gear in a counterclockwise direction. (Converter torque ratio = approximately 2.00:1 at stall.)

Counterclockwise motion of the rear internal gear causes the rear pinions to turn counterclockwise to drive the sun gear clockwise. In turn, the sun gear drives the front pinions counterclockwise, thus turning the front internal gear, output carrier, and output flange counterclockwise in a reduction ratio of approximately 2.48:1. The reaction of the front pinions against the front internal gear is taken by the reaction carrier and roller clutch assembly to the transmission case. (Total stall ratio = approximately 5.00:1).

Downhill or overrun braking is provided in Lo range by applying the rear band, as this prevents the reaction carrier from overrunning the Lo roller clutch.

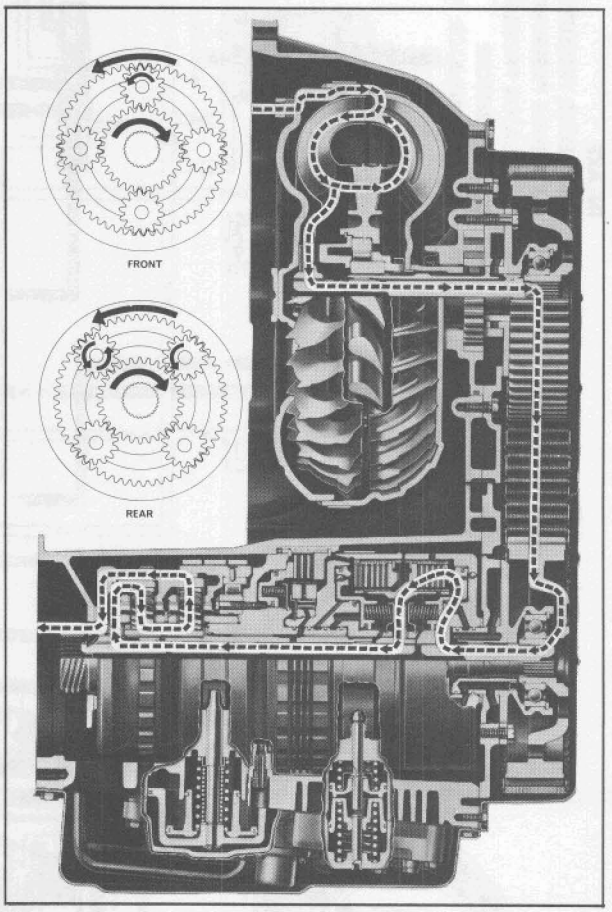


Fig. 7-140 Lo Range - First Gear

OIL FLOW (Fig. 7-141)

Maximum downhill braking can be attained at speeds below approximately 45 mph, with the selector lever in Lo position as this directs Lo oil from the manual valve to the:

1. Rear Servo
2. 1-2 Accumulator Valve
3. Detent Regulator Valve
4. 1-2 Shift Valve

Basic Control

Lo oil flows past a ball check to the apply side of the rear servo piston and to the 1-2 accumulator valve to raise the 1-2 accumulator oil to line pressure for a smooth band apply. Lo oil acts on the detent regulator valve. Combined with the detent spring, Lo oil holds the detent valve against line oil acting on the detent valve, causing drive oil to flow through the detent regulator valve into the detent and modulator passages. Modulator and detent oil at line pressure acting on the 1-2 modulator valve overcomes governor oil and Lo oil on the 1-2 shift valve at any vehicle speed below approximately 40 mph, and the transmission will shift to first gear. Lo oil acts on a small area of the 1-2 shift valve to prevent the 2-1 shift occuring at too high a vehicle speed.

In first speed - Lo range, the transmission cannot upshift to second speed regardless of vehicle or engine speed.

Summary

The forward clutch and rear band are applied. The transmission is in first speed - Lo range.

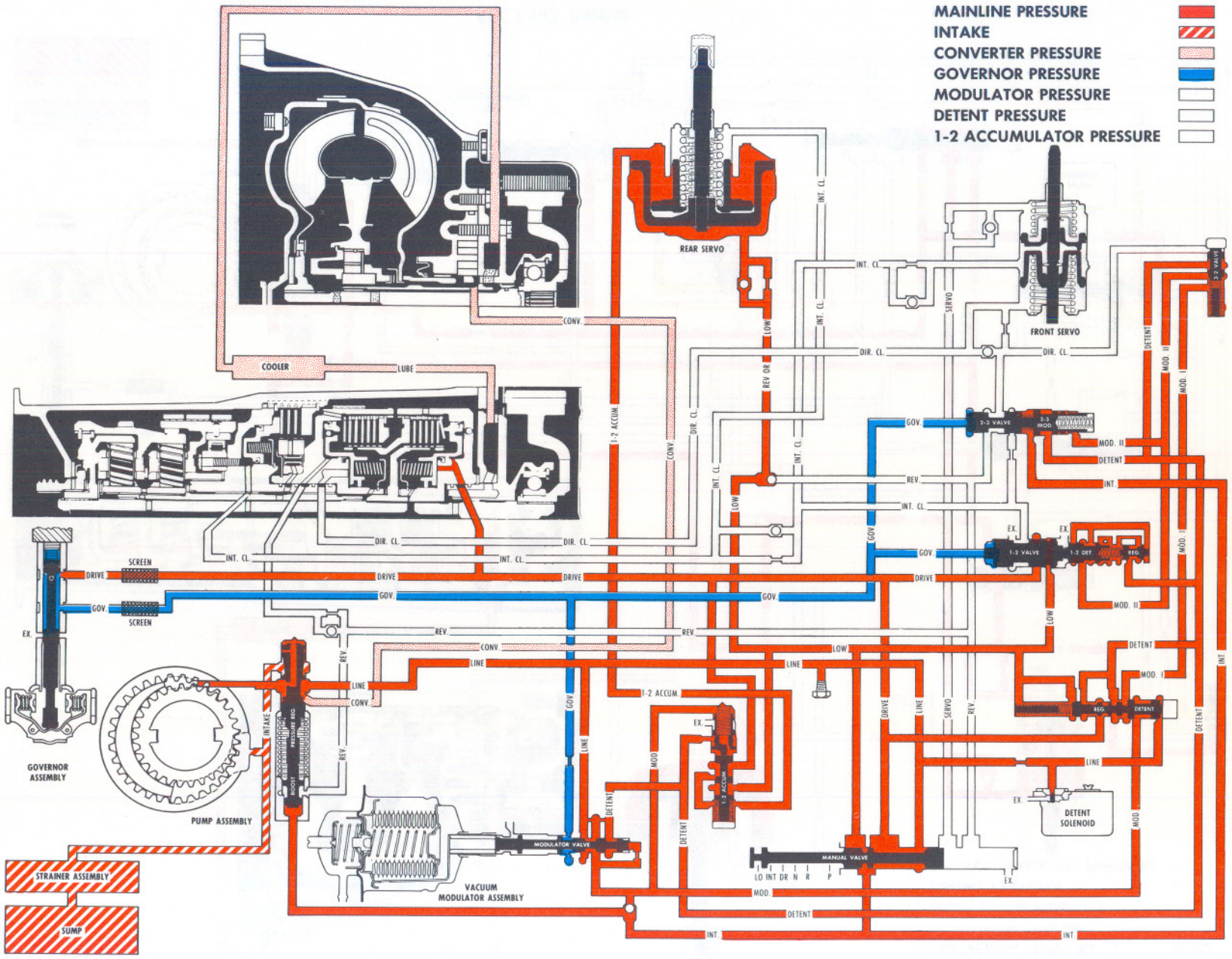


Fig. 7-141 Lo Range - First Gear

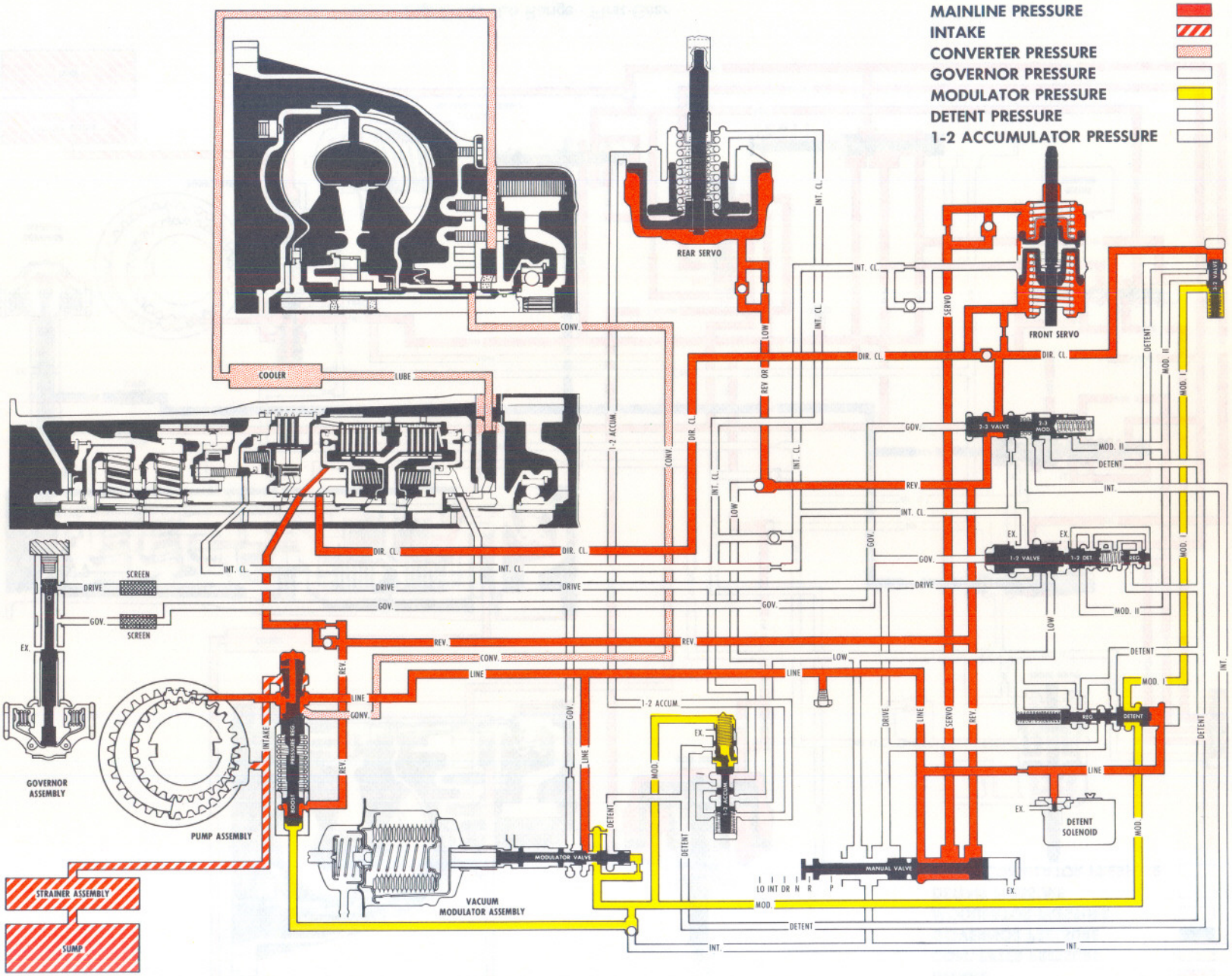


Fig. 7-143 Reverse

REVERSE
POWER FLOW (Fig. 7-142)

Forward Clutch - Released
Roller Clutch - Ineffective
Direct Clutch - Applied
Front Band - Released
Rear Band - Applied
Intermediate Clutch - Released
Intermediate Sprag - Ineffective

In Reverse, the direct clutch is applied to direct turbine torque through the drive sprocket, link assembly and driven sprocket to the sun gear shaft and sun gear. The rear band is applied, holding the reaction carrier.

Counterclockwise torque to the sun gear causes the front pinions and front internal gear to turn clockwise in reduction. The front internal gear is connected directly to the output flange, thus providing the reverse output gear ratio of approximately 2.08:1. The reverse torque multiplication at stall (converter and gear ratios) is approximately 4.00:1.

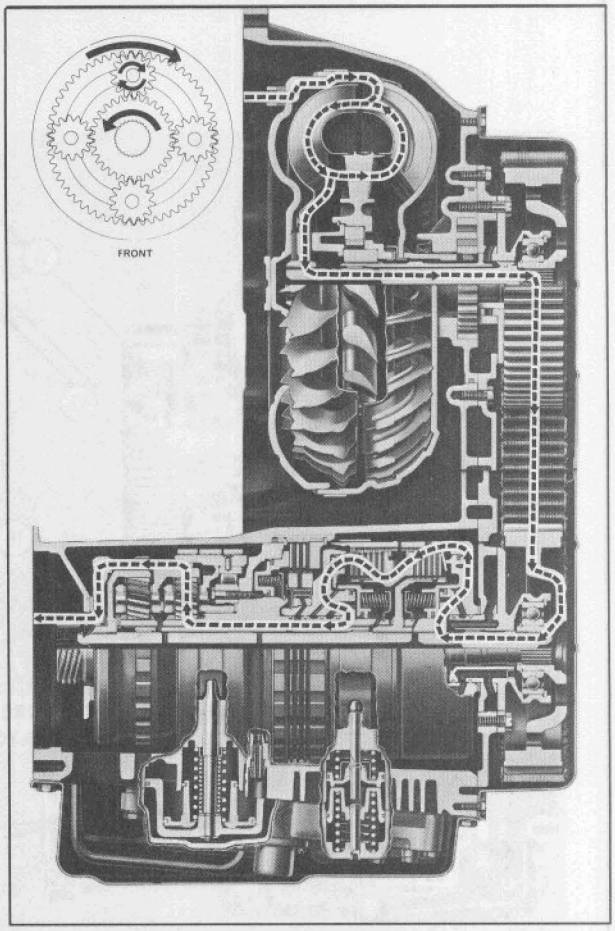


Fig. 7-142 Reverse

OIL FLOW (Fig. 7-143)

When the selector lever is moved to the Reverse position, the manual valve is positioned to allow line pressure to enter the reverse circuit. Reverse oil then flows to the:

1. Direct Clutch
2. 2-3 Shift Valve
3. Rear Servo Piston
4. Pressure Boost Valve

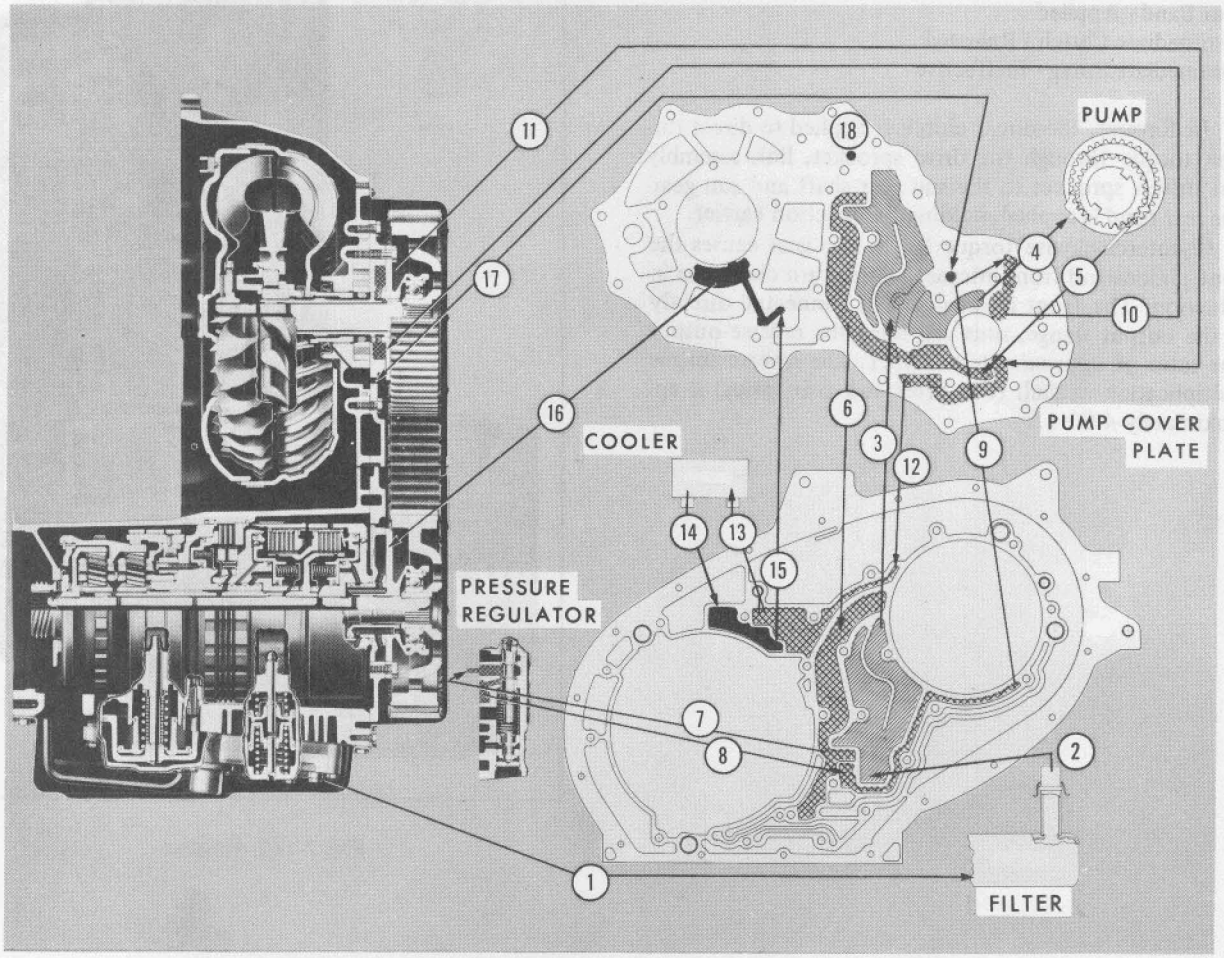
Basic Control

Reverse oil from the manual valve flows to the large area of the direct clutch piston and to the 2-3 shift valve. From the 2-3 shift valve, it enters the direct clutch passage and is directed to the small area of the direct clutch piston to apply direct clutch.

Reverse oil flows to the rear servo and acts on the servo piston to apply the rear band. Reverse oil also acts on the pressure boost valve to boost line pressure.

Summary

The direct clutch and the rear band are applied. The transmission is in Reverse.



1 OIL FROM SUMP TO FILTER
2 FILTER TO CASE PASSAGE
3 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
4 PUMP COVER PLATE PASSAGE TO PUMP
5 PUMP TO PUMP COVER PLATE PASSAGE
6 PUMP COVER PLATE PASSAGE TO CASE PASSAGE
7 CASE PASSAGE TO PRESSURE REGULATOR VALVE
8 PRESSURE REGULATOR VALVE TO CASE PASSAGE
9 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
10 PUMP COVER PLATE PASSAGE TO CONVERTER
11 CONVERTER TO PUMP COVER PLATE PASSAGE
12 PUMP COVER PLATE PASSAGE TO CASE PASSAGE
13 CASE PASSAGE TO COOLER
14 COOLER RETURN TO CASE PASSAGE
15 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
16 PUMP COVER PLATE PASSAGE TO TRANSMISSION POWER TRAIN (ALL INTERNAL LUBRICATION)
NOTE: THE NUMBERS IN THE CROSS SECTION INDICATE THAT THERE ARE ADDITIONAL LUBRICATION HOLES IN THIS AREA THAT ARE NOT SHOWN IN THE CROSS SECTION
17 FRONT SEAL DRAIN BACK HOLE
18 PRESSURE REGULATOR VENT HOLE

Fig. 7-144 Lubrication Chart

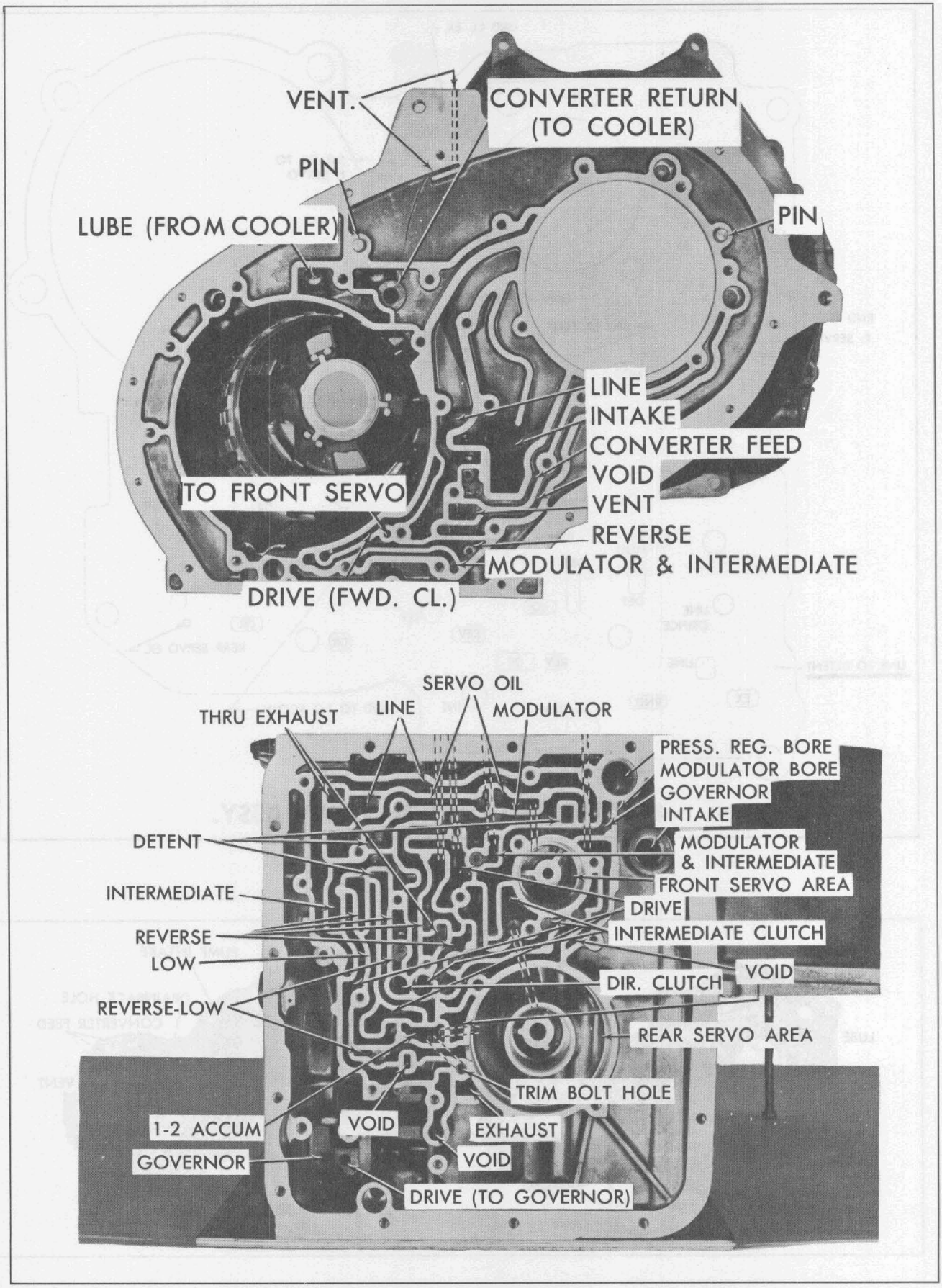


Fig. 7-145 Case Oil Passages - Front and Bottom Views

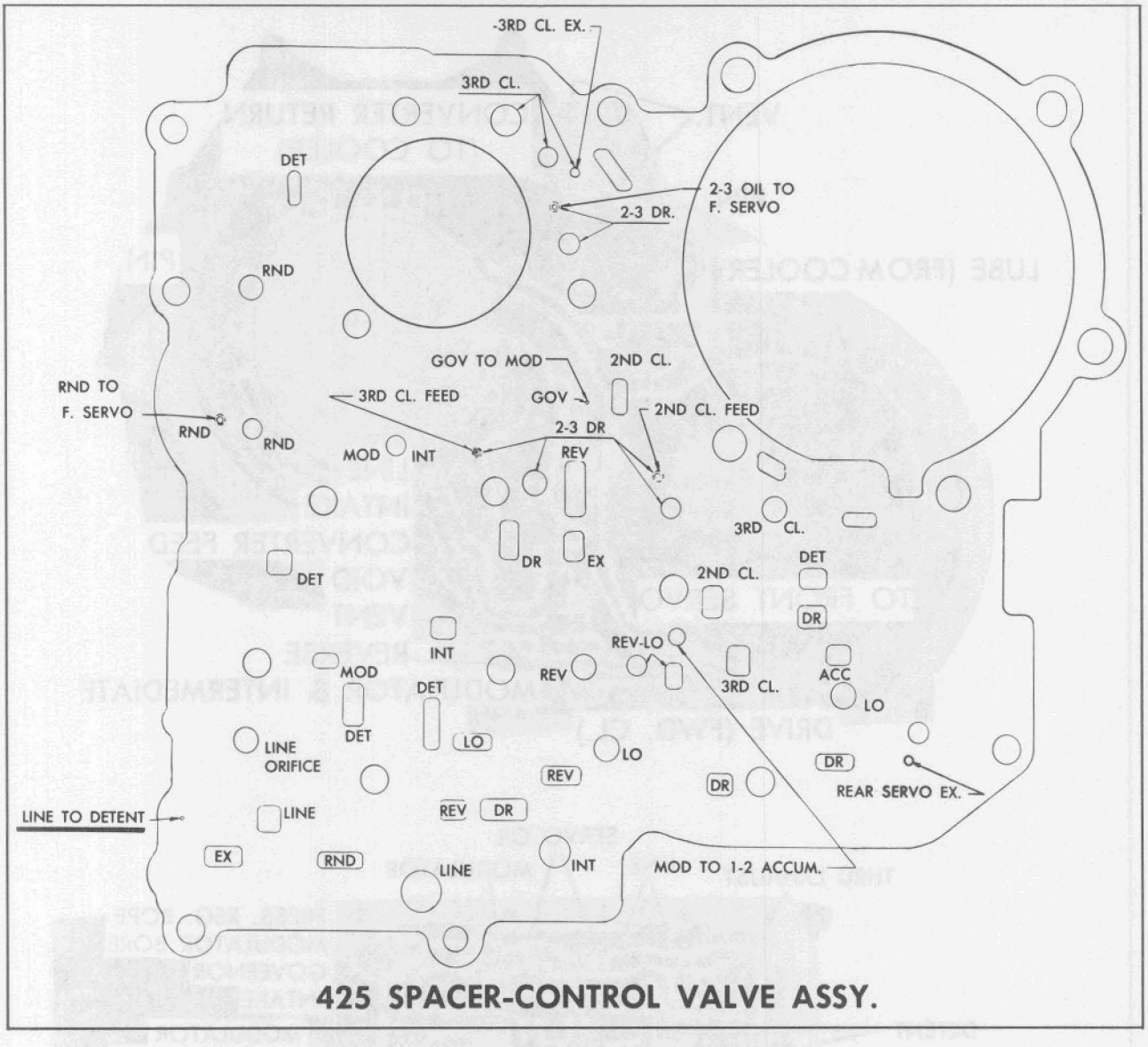


Fig. 7-146 Spacer for Control Valve Assembly

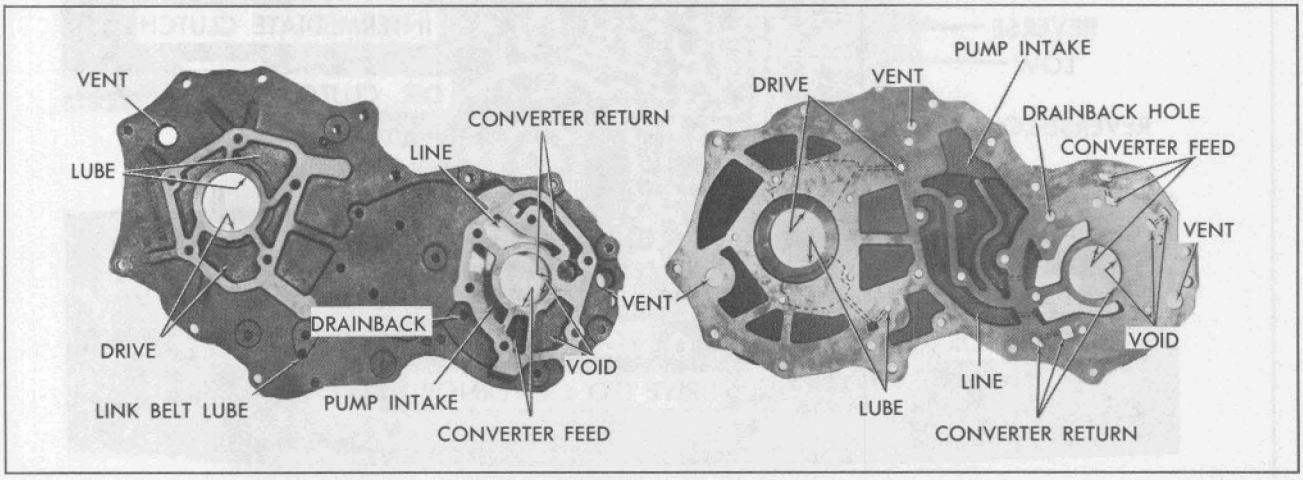


Fig. 7-147 Pump Cover Oil Passages

18. Fluid Leakage Precautions

The fluid leakage precautions are listed in Note 1.

19. Points of Possible Oil Leaks

When checking for oil leaks, first determine whether leak originates from transmission or engine. The original factory fill fluid in the transmission is formulated with a red aniline dye to assist in locating leaks. If the color of the dye cannot be detected in the transmission fluid, the fluid should be changed. Red dye appearing in the leaking oil will give positive identification as to the location of the leak.

If oil leak is found to be in transmission, check for leak in following areas:

19a. Rear End

It will be necessary to remove converter cover to determine location of leaks at rear end. To correct leaks at rear end, it will be necessary to remove transmission from car.

1. Pump oil seal leak - Check pump oil seal to make certain it is correctly installed and not damaged.

When installing a new pump oil seal, make certain that bore is free from foreign material and that garter spring on seal is correctly positioned. Check finish of converter neck and bearing surface in pump body.

2. Pump assembly-to-case O-ring damaged.
3. Converter - Inspect converter for indications of leakage. See Note 14 for checking procedure.
4. Vent fitting damaged.

19b. Cover and Plate Assembly Sprocket Housing Leak

1. Attaching bolts not correctly torqued.
2. Housing to case gasket improperly installed or damaged.
3. Housing to case gasket face not flat.

19c. Final Drive to Transmission Leak

1. Attaching bolts not correctly torqued.
2. Final drive to transmission gasket improperly installed or damaged.
3. Mounting surfaces not flat.

19d. Transmission Case

1. Speedometer driven gear housing retainer attaching screw loose. Tighten to 18 foot-pounds.
2. Speedometer driven gear housing O-ring or lip seal damaged.
3. Governor cover bale-type attaching retainer not tight.
4. Damaged governor O-ring.
5. Solenoid connector terminal O-ring damaged.
6. Manual shaft O-ring damaged.
7. Vacuum modulator damaged.
8. Vacuum modulator retainer screw loose. Tighten to 18 foot-pounds.
9. Vacuum modulator diaphragm damaged. Check as described in Note 3w.

(NOTE: A ruptured diaphragm would allow transmission oil to be drawn into intake manifold and vacuum line. Usually the exhaust will be excessively smoky due to transmission oil added to the combustion. Oil level of transmission will also be low.)

10. Bottom pan gasket damaged.
11. Bottom pan attaching screws loose, Tighten to 12 foot-pounds.
12. Line pressure plug not tight. Tighten to 10 foot-pounds.
13. Porous or cracked casting.
14. Vent pipe.
    a. Transmission over-filled.
    b. Water in oil.
    c. Pump to case gasket mispositioned.
    d. Foreign material between pump and case, or between pump cover and body.
    e. Case - Porous, pump face improperly machined.
    f. Pump - Shy of stock, porous.

19e. Oil Cooler Pipe Connections

1. Outside oil cooler pipe connections improperly installed or damaged. Also connectors in radiator and transmission.
2. Oil cooler pipe connections not tight. Tighten to 28 foot-pounds at transmission and 40 foot-pounds at radiator.
3. Flare on oil cooler pipes damaged at radiator or transmission.

19f. Filler Pipe

1. O-ring damaged or improperly installed on pipe.
2. Filler pipe not fully seated in case.

19g. Internal Leaks

It will be necessary to remove bottom pan to determine location of internal leaks.

1. Governor pipes damaged.
2. Control valve assembly-to-spacer or case gaskets damaged.
3. Control valve assembly attaching screws loose. Tighten to 8 foot-pounds.
4. Solenoid gaskets damaged.

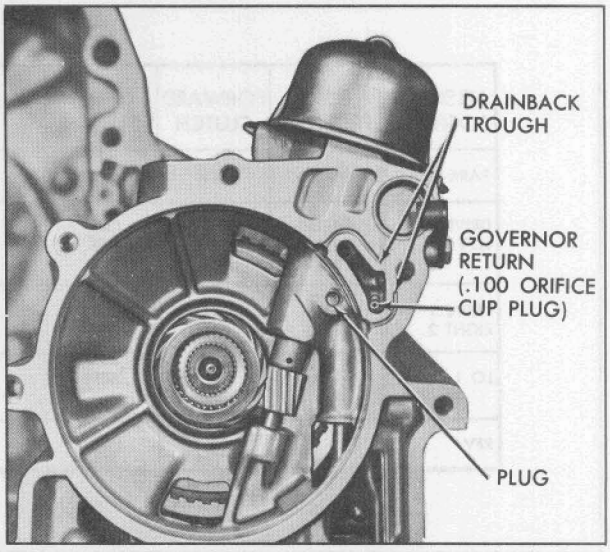
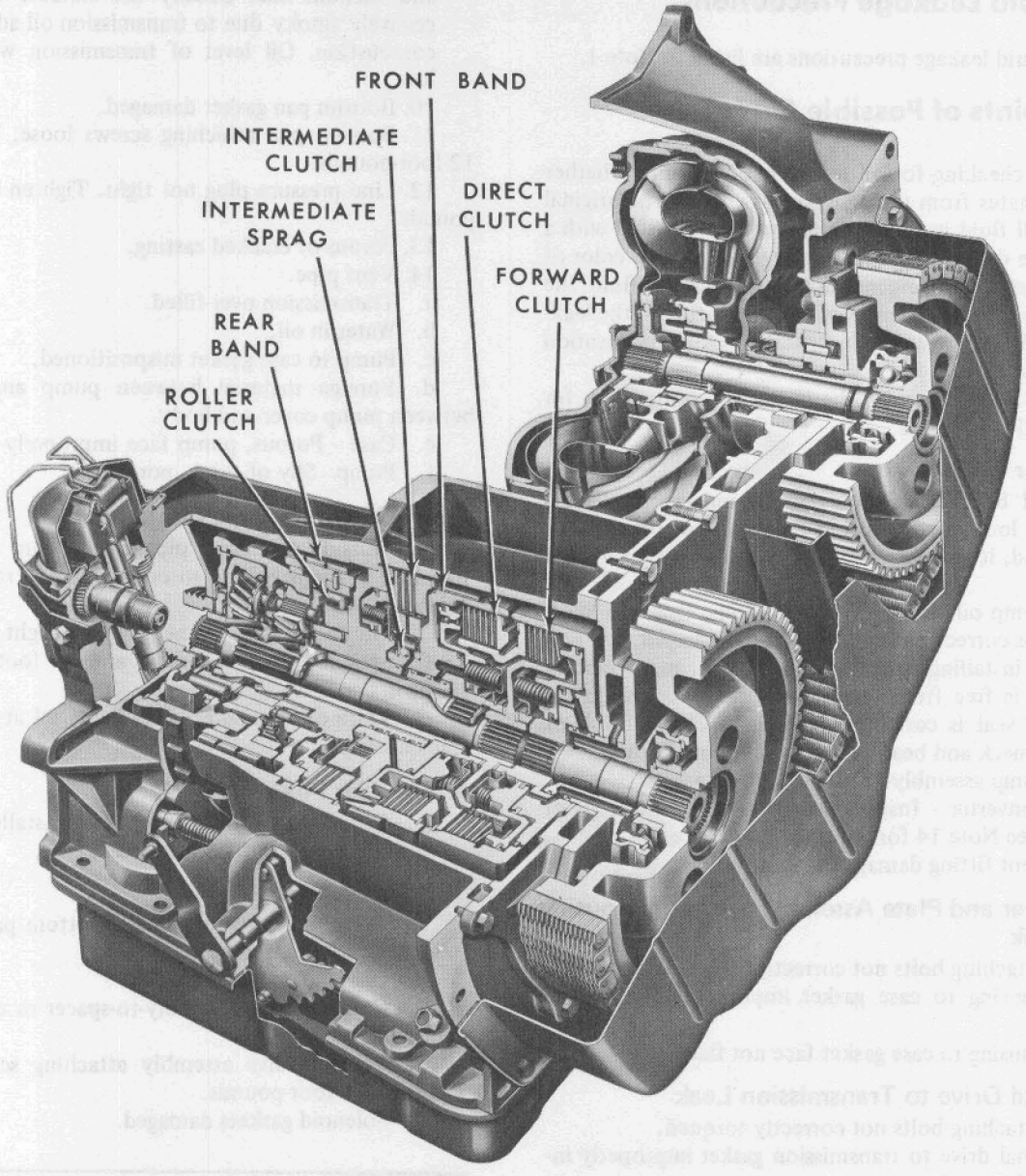


Fig. 7-148 Governor Oil Passages



SELECTOR POSITION	PUMP PRESSURE	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INT. CLUTCH	INT. SPRAG	ROLLER CLUTCH	REAR BAND
PARK—NEUT.	60-150	OFF	OFF	OFF	OFF	OFF	OFF	OFF
DRIVE 1	60-150	ON	OFF	OFF	OFF	OFF	ON	OFF
LEFT 2	60-150	ON	OFF	OFF	ON	ON	OFF	OFF
3	60-150	ON	ON	OFF	ON	OFF	OFF	OFF
DRIVE 1	150	ON	OFF	OFF	OFF	OFF	ON	OFF
RIGHT 2	150	ON	OFF	ON	ON	ON	OFF	OFF
LO 1	150	ON	OFF	OFF	OFF	OFF	ON	ON
2	150	ON	OFF	ON	ON	ON	OFF	OFF
REV.	95 - 230	OFF	ON	OFF	OFF	OFF	OFF	ON

Fig. 7-149 Band, Sprag and Clutch Application Chart

5. Solenoid attaching screws loose. Tighten to 8 foot-pounds.
6. Intake pipe O-ring damaged.
7. Rear servo square cut O-ring improperly installed or damaged.

DIAGNOSIS

(NOTE: The following information is applicable to the Eldorado only. Where service procedures are similar to the Turbo Hydra-matic transmission used on other 1972 Cadillac models, reference will be made to the appropriate note in the forward part of this section.)

CAUTION: In the event of a major transmission failure, replace filter assembly and flush oil cooler and oil cooler lines.

It is particularly important in the case of a converter failure to perform these service procedures.

20. Turbo Hydra-Matic 425 Diagnosis Procedure

The diagnosis procedures for the Turbo Hydra-matic transmission used on the Eldorado are identical to the procedures given in Note 3, with the following exceptions:

1. Figures 7-141 through 7-147 are to be used in place of Figures 7-20, 7-21 and 7-22, when diagnosing a Eldorado Turbo Hydra-matic transmission.
2. Transmission Noise - Sprocket and Link Assembly.

a. Link assembly too long. Sounds similar to pop corn popping. (There will be a rough burr along the teeth of the drive sprocket if the link assembly is too long). Replace sprocket and link assembly.
b. Drive or Driven sprocket teeth damaged.
c. Engine mounts worn or damaged.

e. Model AJ Clutch Parts

Clutch	No. of Flat Steel Clutch Plates	No. of Waved Steel Clutch Plates
Forward Clutch	5	*1
Direct Clutch	5	1
Intermediate Clutch	3	--

*Clutch Plate Dished

Clutch	No. of Clutch Composition Plates	No. of Piston Release Springs
Forward Clutch	5	16
Direct Clutch	6	14
Intermediate Clutch	3	6

SERVICE INFORMATION

21. Manual Linkage Adjustment (Fig. 7-150)

(NOTE: Cotter pins removed to be discarded and replaced with new cotter pins.)

1. Pull relay rod up to position transmission shift valve in Park, then push rod down to the third (Neutral) step. Make sure rod is centered in this detent position.
2. Loosen adjusting screw on relay lever.
3. Position selector lever in Neutral detent in steering column.
4. Tighten relay rod adjusting screw, making sure shift lever is held against Neutral stop while this operation is being performed.
5. Check operation of selector lever by performing the following steps:

a. Lift lever and move to Neutral detent. (This is the detent in the transmission.) Release the lever and check to make sure that the lever fits into the neutral notch in the steering column.
b. Move lever to Drive detent. There should be a slight travel of the lever beyond this detent until the drive stop in the steering column is reached.
c. Move lever to Reverse detent and check as in b above.

WARNING: WHENEVER LINKAGE IS READJUSTED, CHECK FOR PROPER OPERATION OF NEUTRAL SAFETY SWITCH, PARKING BRAKE RELEASE AND BACK-UP LIGHTS. REFER TO SECTION 12, NOTE 41 FOR PROPER METHOD OF CHECKING FUNCTION OF NEUTRAL SWITCH.

22. Transmission Downshift Switch Adjustment

The procedure for adjusting the transmission downshift switch is described in Note 5.

23. Downshift Solenoid Circuit Check

The procedure for checking the downshift solenoid circuit is described in Note 6.

24. Checking and Adding Fluid

(NOTE: Car level and oil temperature are particularly important when checking fluid level on a Turbo Hydra-matic transmission. Careful attention to the

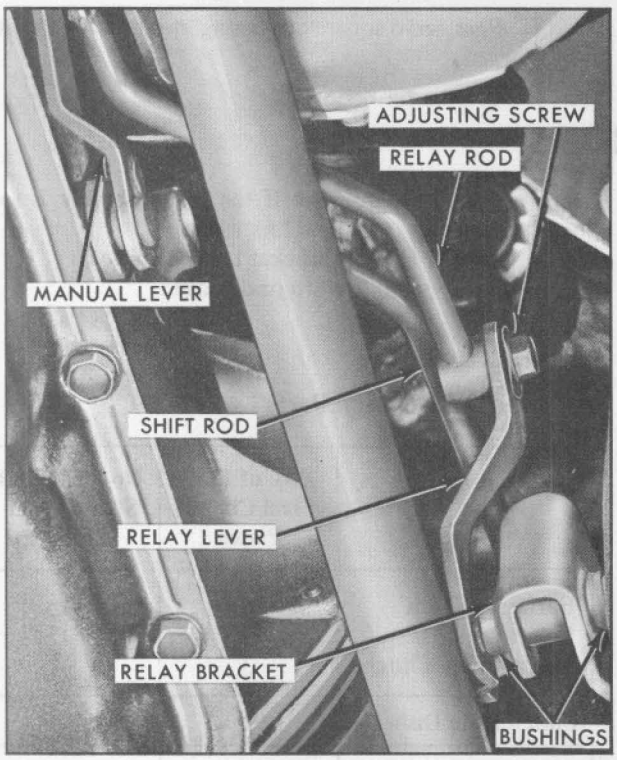


Fig. 7-150 Adjusting Manual Linkage

following procedures is necessary in order to determine the actual fluid level.

24a. Turbo Hydra-Matic Oil Recommendations

Whenever fluid is added to the 1972 Eldorado transmission use only DEXRON® type transmission fluid, or fluids of equivalent quality that have been especially formulated and tested for use in the Turbo Hydra-matic transmission.

The transmission dipstick and filler tube on the 1972 Eldorado is located under the hood at the left center side of engine.

The bottom pan should be drained every 24,000 miles, and fresh fluid added to obtain the proper level on the dipstick Fig. 7-151. For cars subjected to heavy city traffic during hot weather, or in commercial use, when the engine is regularly idled for prolonged periods, the bottom pan should be drained every 12,000 miles.

The oil intake system incorporates an intake pipe and filter assembly that should also be replaced after the first 24,000 miles. In any case of a major transmission failure, the filter assembly must be replaced.

24b. Checking and Adding Fluid

Fluid level should be checked at every engine oil change. The full "F" and "ADD" dimple marks on the transmission dipstick indicate one pint difference. Correct fluid level is determined at normal operating temperature (180°F - 190°F). Careful attention to transmission oil temperature is necessary, as proper fluid level at low operating temperatures will be below the "ADD" mark on the dipstick, Fig. 7-151, and proper fluid level at higher operating temperatures will rise above the full "F" mark. Fluid level must always be checked with car on level surface, and with engine running to make certain converter is full. To determine proper fluid level, see Note 7b for procedure.

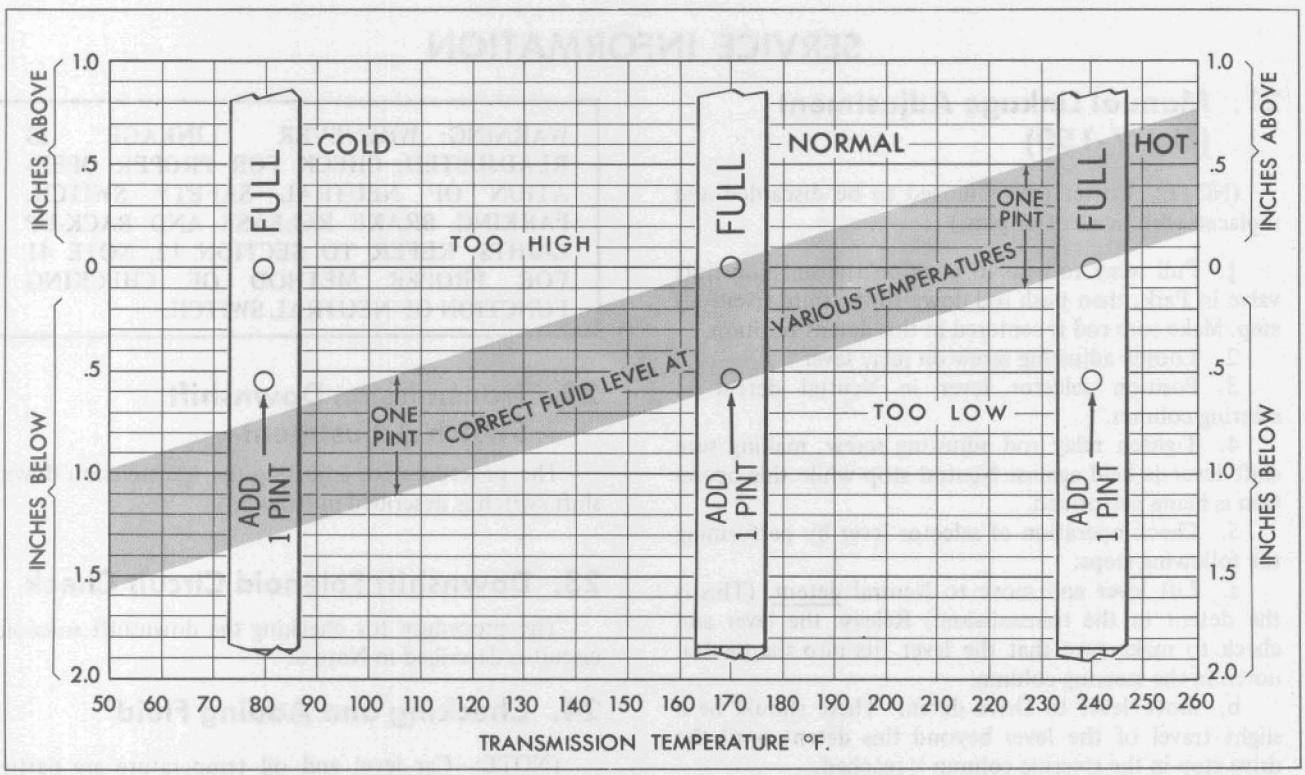


Fig. 7-151 Transmission Oil Level (693 Only)

24c. Draining Bottom Pan and Replacing Intake Pipe and Filter Assembly

To drain bottom pan only, eliminate steps 5 and 6.

1. Remove dipstick from filler tube and insert a length of hose secured to a suction gun down the dipstick. Remove enough transmission fluid so that bottom pan will not overflow when removed.
2. Raise car on hoist or place on jack stands, and provide container to collect draining oil.
3. Remove bottom pan and gasket. Discard gasket.
4. Drain fluid from bottom pan. Clean pan with solvent and dry thoroughly with clean compressed air.
5. Remove intake pipe and filter assembly. Remove and discard intake pipe O-ring.
6. Install new intake pipe O-ring into pipe bore in transmission case and install new intake pipe and filter assembly.
7. Install new gasket on bottom pan and install bottom pan. Tighten bottom pan attaching screws to 12 foot-pounds.
8. Lower car and add five quarts of transmission fluid through filler tube when replacing intake pipe and filter assembly. When draining bottom pan only, add four quarts of transmission fluid.
9. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.
10. Reduce engine speed to slow idle and check fluid level. Add fluid to bring to proper level, Fig. 7-151.

24d. Adding Fluid to Dry Transmission and Converter Assembly

The fluid capacity of the Turbo Hydra-matic transmission and converter assembly is approximately 13 quarts, but correct level is determined by mark on dipstick rather than by amount added. It is important that proper level be maintained. In cases of transmission overhaul, when a complete fill is required, including converter, proceed as follows:

1. Add 9 quarts of transmission fluid through filler tube.

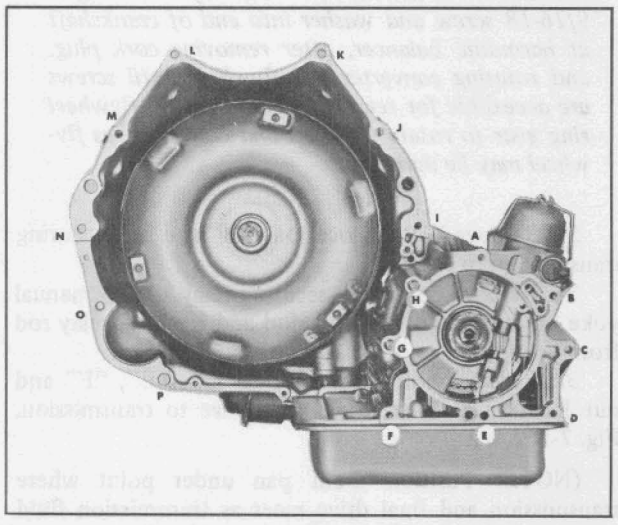


Fig. 7-152 Transmission Attaching Bolts

2. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.
3. Reduce engine speed to slow idle.
4. Check fluid level and add additional fluid to bring to proper level, Fig. 7-151.

24e. Sprocket Housing Cover Removal

If the sprocket housing cover is removed, add transmission oil as described in part b.

25. Towing Instructions

Refer to Page 0-4 for towing instructions pertaining to 1972 Cadillac Eldorados.

26. Units That Can Be Removed With Transmission in Car

The following units can be removed from the transmission without removing transmission from car.

While the detailed procedure for removing each of the units is not outlined separately, the procedures covered under the transmission disassembly and assembly will apply.

26a. Governor Assembly

Removal - Note 29b
Disassembly - Note 30k
Installation - Note 30k

26b. Speedometer Driven Gear Assembly and Speed Controlled Spark Switch

Removal - Note 29c
Installation - Note 30k

26c. Intake Pipe and Filter Assembly and Bottom Pan

Removal - Note 29d
Installation - Note 30j

26d. Control Valve Assembly, Governor Pipes, Detent Spring and Roller Assembly, and Check Balls

Removal - Note 29f
Disassembly - Note 30i
Installation - Note 30i

26e. Vacuum Modulator and Valve

Removal - Note 29a
Installation - Note 30j

26f. Pressure Regulator

Removal - Note 29e
Installation - Note 30j

26g. Front Servo and Rear Servo and Accumulator Assembly

Removal - Note 29g
Disassembly - Note 30h
Installation - Note 30h

26h. Detent Lever, Manual Shaft, and Parking Linkage

Removal - Note 29i
Installation - Note 30h

27. Transmission Removal and Installation (Fig. 7-153)

27a. Removal

1. Disconnect negative battery cable.
2. Remove transmission dipstick.
3. Remove bolt securing filler tube bracket to exhaust manifold and remove filler tube, catching fluid in clean pan.
4. Remove and discard O-ring on filler tube.
5. Remove bolts at locations "A", "B" and "C", securing final drive case to transmission, Fig. 7-152.
6 Disconnect speedometer cable from governor assembly and unplug electrical connector.
7. Disconnect oil cooler pipes at transmission using an open end wrench or crowfoot adapter and position out of way. Cap pipes and plug connector holes in transmission.
8. Remove bolt securing cooler pipe bracket to final drive bracket and position pipes outboard of governor assembly.
9. Remove nut at location "H", securing final drive case to transmission, Fig. 7-152.
10. Remove bolts at locations "I", "J", "K" and "L", securing transmission to engine, Fig. 7-152. Vacuum modulator line bracket is also attached "L".
11. Remove upper left bolt and lockwasher securing rear engine mount bracket to transmission.
12. Remove ground strap from cowl.
13. Remove upper left bolt securing converter cover plate to transmission by using a 7/16 inch universal socket and extension. Bolt can be seen from engine compartment.
14. Install Engine Support, J-22825, in engine with legs over upper suspension arm support brackets and brackets on tool over tie struts, Fig. 7-153.
15. Remove two bolts securing brake combination valve to bracket.
16. Raise vehicle.
17. Remove two bolts securing bracket to frame and remove bracket.
18. Lower vehicle and carefully move valve inward toward engine just enough to allow clearance for engine support fixture at frame. Use care to avoid damage to brake lines.
19. Install hooks under exhaust manifolds. Tighten bolts at legs and nuts at chains so that chains are in true vertical position and put engine mounts under tension.

(NOTE: Chains should be in true vertical position to minimize transmission to engine alignment during installation.)

20. Raise car.
21. Disconnect leads from starter motor.
22. Remove bolt at location"O" securing starter motor to transmission case and remove ground strap from bolt.
23. Holding starter, remove bolt at location "P", Fig. 7-152 and remove starter and starter wiring clip.
24. Remove three remaining bolts securing converter cover plate to transmission and remove cover plate.
25. Position transmission jack, equipped with front end drive transmission adapter plate, to transmission and install bolt securing adapter brace to transmission at starter motor lower mounting hole, Fig. 7-154.
26. Disconnect transmission downshift switch connector at transmission.
27. Remove vacuum pipe from vacuum modulator.
28. Secure transmission to transmission jack adapter plate with safety chain.
29. Remove three flywheel to converter attaching bolts.

CAUTION: This can be done by installing a 9/16-18 screw and washer into end of crankshaft at harmonic balancer, after removing cork plug, and rotating converter and flywheel until screws are accessible for removal. Do not pry on flywheel ring gear to rotate flywheel and converter, as flywheel may be damaged.

30. Remove bolts at locations "M" and "N" securing transmission to engine.
31. Remove cotter pin securing relay rod to manual yoke on left side of transmission and separate relay rod from yoke.
32. Remove bolts at locations "E", "E", "F" and nut location "G", securing final drive to transmission, Fig. 7-152.

(NOTE: Position drain pan under point where transmission and final drive meet as transmission fluid will be lost when transmission and final drive are separated.)

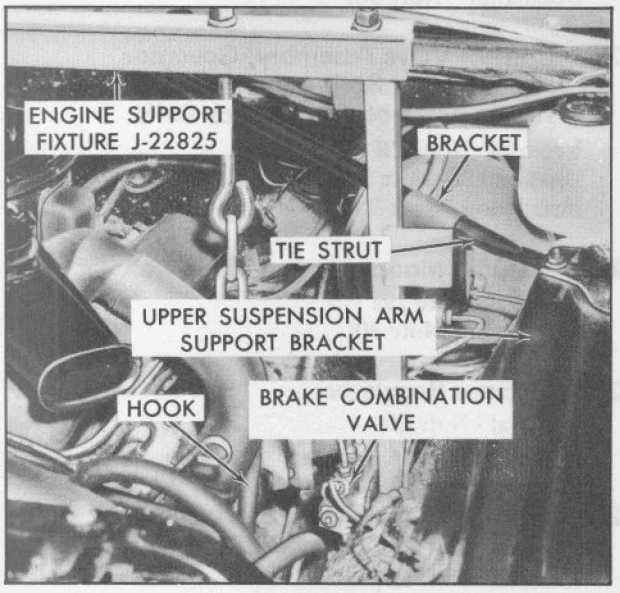


Fig. 7-153 Supporting Engine

33. Remove five bolts and washers securing rear of acromat to front cross bar and frame horns and allow acromat to hang free.

34. Through access holes in bottom of front frame cross member remove two nuts and studs securing front engine mounts to front frame cross member and engine.

35. Turn wheels all the way to left.

(NOTE: This will give final drive additional clearance when it is pried forward.)

36. Have helper, using large pry bar, shift engine assembly forward, while technician performing operation uses small pry bar to help separate transmission from engine and final drive.

CAUTION: Select pry points with care to avoid damaging any components. Final drive unit is limited in its forward travel.

37. After initial separation has been made, allow transmission oil to drain at final drive junction.

38. Remove two bolts and lockwashers on right side, securing rear engine mount bracket to transmission.

39. Through access holes in bottom of transmission support bar, remove two bolts, one each side, securing rear motor mounts to transmission support bar, and position motor mounts and bracket rearward to underbody.

40. While helper pries and holds engine assembly forward, move transmission rearward to disengage transmission case from dowels on engine adapter and to disengage final drive from studs on transmission case. Top of transmission should be tilted slightly rearward.

CAUTION: Final drive unit is limited in its forward travel.

41. Slowly lower transmission, making certain top of transmission case clears flex plate ring gear and splined input shaft of final drive, until converter is approximately half-way exposed from flex plate.

42. Install Converter Holding Clamp, J-21366, using a 5/16-18 nut to hold clamp screw to transmission case at location "N".

CAUTION: Converter Holding Clamp, J-21366, must be used to avoid the possibility of the converter becoming disengaged when the transmission is removed.

43. Lower transmission from car.

WARNING: REAR ENGINE MOUNT BRACKET WILL FOLLOW THE TRANSMISSION FROM CAR; TO AVOID DAMAGE OR INJURY, REMOVE THE BRACKET AS SOON AS THERE IS SUFFICIENT CLEARANCE.

44. Remove and discard final drive gasket and clean mounting surface of final drive.

27b. Installation

1. Position transmission on jack equipped with adapter plate, under car.

2. Install new gasket on final drive, after first soaking gasket with transmission fluid.

3. Position rear engine mount bracket on top of transmission support bar against underbody.

4. Raise transmission in place until converter is approximately half-way covered by flywheel, and then remove Converter Holding Clamp, J-21366, from Transmission.

5. While helper assists by holding engine assembly forward with pry bar, continue raising transmission, making certain top of transmission case clears splined input shaft of final drive, and position to engine.

6. Position transmission to engine assembly and final drive by aligning the following points in order listed, while helper assists:

a. Studs on transmission case to mounting holes in final drive.

b. Guide holes in transmission case to dowels on engine crankcase.

c. Internal flange on final drive to transmission.

CAUTION: As engagement of splined final drive input shaft to transmission is hidden, extreme care must be taken to avoid damaging transmission or final drive assembly.

d. To facilitate engagement of final drive splines, rotate one front wheel while helper holds other.

(NOTE: When alignment is complete and proper, gap between final drive case and transmission should not exceed 1/4 inch.)

7. Loosely install bolts (3/8-16 x 1-1/4) at locations "D" and "F" attaching transmission to final drive and bolt (3/8-16 x 2-1/2) at location "N" attaching transmission to engine, Fig. 7-152. Alternately tighten bolts to avoid cocking transmission. Do not torque bolts at this time.

8. Working in engine compartment, loosely install bolts (3/8-16 x 1-3/8) at location "J" attaching transmission to engine crankcase, Fig. 7-152. Do not torque bolt at this time.

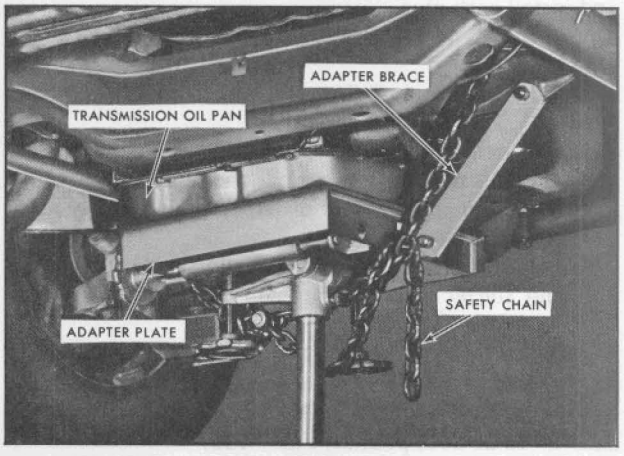


Fig. 7-154 Positioning Transmission Jack

9. Install bolt (3/8-16 x 1-3/8) at location "M" attaching transmission to engine, Fig. 7-152. Do not torque bolt at this time.

10. Position rear engine mount brackets to transmission and loosely install three bolts and lockwashers securing bracket to transmission.

(NOTE: Upper left bolt is installed from engine compartment.)

11. Position rear engine mounts and bracket to transmission support bar and loosely install bolts through access holes in bottom of bar, attaching mounts to bar.

12. Reposition engine assembly, as necessary, and install two studs and nuts securing front motor mount to front frame crossmember. Tighten both front motor mount nuts to 30 foot-pounds.

13. Remove safety chain, remove bolt securing jack adapter plate to transmission case and remove transmission jack.

14. Torque the following bolts as specified.

a. Rear engine mounts to transmission support bar - 55 foot-pounds.

b. Rear engine mount to transmission (two on right side) - 55 foot-pounds.

c. Transmission to engine (location "M" and "N", Fig. 7-152) - 30 foot-pounds.

CAUTION: The procedure for attaching the converter to the flywheel as described in steps 15 through 17 must be strictly followed. Any deviation from this procedure will result in improper installation and damage to flywheel and transmission.

15. Rotate converter until two of the three weld nuts on converter line up with two of the three holes in flywheel. Position converter so that weld nuts are flush with flywheel, making certain converter is not cocked and that pilot in center of converter is properly seated in crankshaft.

16. Install two flywheel to converter attaching bolts through accessible holes in flywheel and tighten finger tight.

17. Rotate flywheel and converter by rotating screw previously installed in forward end of crankshaft, until third hole is accessible. Install third bolt and tighten all bolts to 28 foot-pounds. Remove screw from crankshaft and install cork plug.

18. Install vacuum hose on vacuum modulator assembly.

19. Install transmission downshift switch at connector.

20. Position converter cover plate to transmission case and install two lower and one upper right bolts securing cover plate to transmission, tightening to 5 foot-pounds.

21. Position starter to transmission case and install bolt and starter motor wiring clip at location "P", Fig. 7-152.

22. Position ground strap to transmission and install bolt securing ground strap and starter motor to transmission at location "O". Tighten bolts at locations "O" and "P" to 25 foot-pounds, Fig. 7-152.

23. Install leads on starter motor.

24. Install bolts at locations "C" and "E" and nut at location "G", securing transmission to final drive, Fig. 7-152.

25. Torque bolts at locations "C" through "F" to 25 foot-pounds, Fig. 7-152.

26. Position acromat to front cross bar and frame horns and install five retaining bolts and washers.

27. Position relay rod to manual yoke and secure with cotter pin.

28. Check operation of manual linkage and adjust, if necessary, as described in Note 21.

29. Lower car.

30. Remove Engine Support, J-22825.

31. Raise vehicle.

32. Install two bolts securing bracket to frame.

33. Lower vehicle.

34. Install two bolts securing brake combination valve to bracket.

35. Install bolts at location "A" and "B" and nut at location "H", securing transmission to final drive, Fig. 7-152. Tighten bolts to 25 foot-pounds.

36. Install upper left bolt securing converter cover plate to transmission using 7/16 inch universal socket and extension.

37. Install bolts at locations "I", "K" and "L" securing transmission to engine and adapter, Fig. 7-152. Vacuum modulator pipe bracket is also installed at location "L".

38. Torque bolts at locations "I", "J", "K" and "L" to 25 foot-pounds, Fig. 7-152.

39. Tighten brass cooler pipe connectors at case to 28 foot-pounds. Clean ends of cooler pipes with solvent, reposition cooler pipes, and connect pipes to transmission using an open end wrench or crowfoot adapter.

40. Install speedometer cable to governor.

41. Install new O-ring on transmission filler tube and install filler tube through hole in final drive case.

42. Position transmission filler tube bracket to exhaust manifold and install retaining bolt.

43. Install body ground strap to cowl.

44. Plug electrical connector into socket in transmission case.

45. Connect negative battery cable.

46. Fill transmission with fluid as required, see Note 24.

47. Inspect brake lines for possible damage.

28. Installing Transmission on Holding Fixture

1. With transmission on portable jack, remove Converter Holding Clamp, J-21366, and then remove converter assembly from transmission by pulling converter straight out of housing.

CAUTION: Converter with oil weighs approximately 50 pounds. Be careful not to drop or damage converter when removing it.

If transmission is to be overhauled, place converter on opposite end of workbench from transmission Holding Fixture Base.

2. Position Transmission Holding Fixture, J-22240, to transmission, Fig. 7-155.

3. Attach Holding Fixture, J-22240, to transmission using a 3/8-16 x 2-1/4 inch bolt and nut at

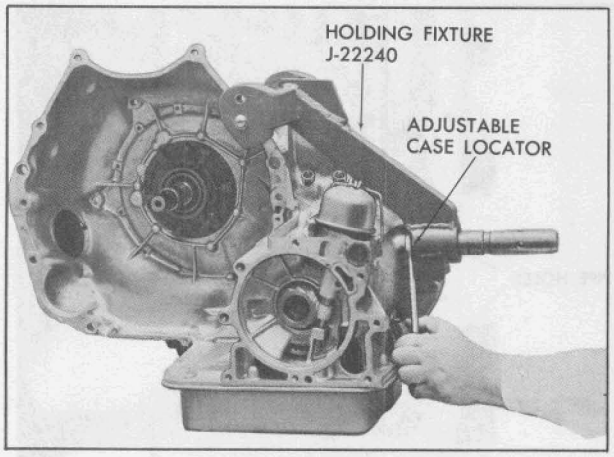


Fig. 7-155 Attaching Transmission Holding Fixture

location "J". Use special screw provided with Holding Fixture to attach Holding Fixture to rear side of transmission case.

4. Tighten adjustable case locator pivot bolt to boss on side of transmission case.

CAUTION: Do not over torque adjustable case locator nut.

5. Install Transmission Holding Fixture, J-22240, and transmission into Holding Fixture Base, J-3289-01, then install lock pin in base.

6. Remove transmission jack from transmission.

7. Provide a container to catch any oil that may drain from transmission.

29. Major Transmission Components Removal (Fig. 7-126)

29a. Remove Vacuum Modulator and Valve

(NOTE: Unit may be removed without removing transmission or bottom pan, after removing vacuum hose.)

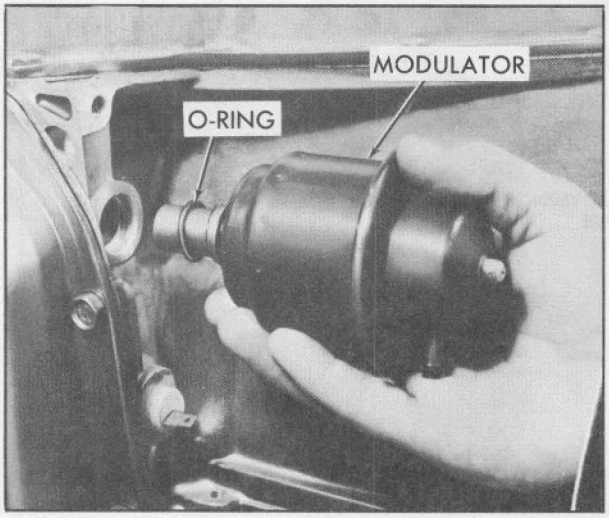


Fig. 7-156 Removing Vacuum Modulator and O-Ring

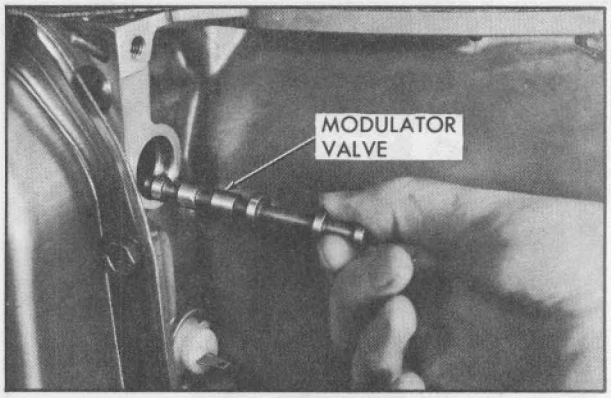


Fig. 7-157 Removing Modulator Valve

1. Remove vacuum modulator attaching screw and retainer from transmission case.

2. Remove modulator assembly and O-ring from transmission case. Remove and discard O-ring from vacuum modulator, Fig. 7-156.

3. Remove modulator valve from transmission case, Fig. 7-157.

(NOTE: Modulator bushing is a tight fit in transmission case and should not be removed forcibly unless it is damaged, scored, or otherwise deformed.)

29b. Remove Governor Assembly

(NOTE: Unit may be removed without removing transmission from car.)

1. Force top of spring clip downward, releasing governor assembly.

2. Remove governor assembly from case, and remove square-cut O-ring from governor assembly and discard O-ring, Fig. 7-158.

(NOTE: The governor assembly, including the driven gear, is replaceable. See Note 30, item k.)

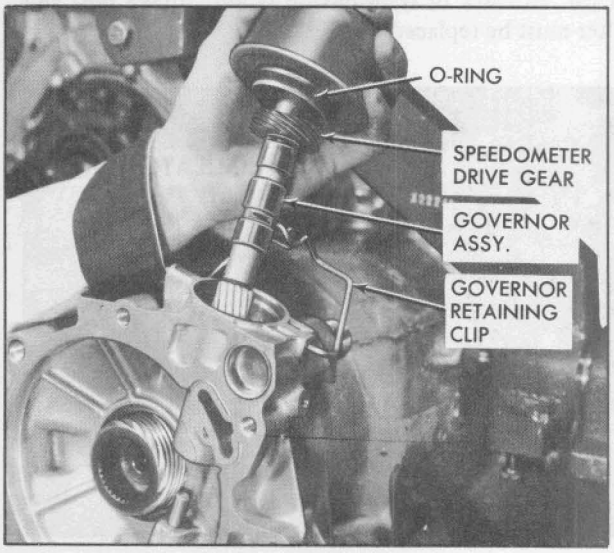


Fig. 7-158 Removing Governor Assembly

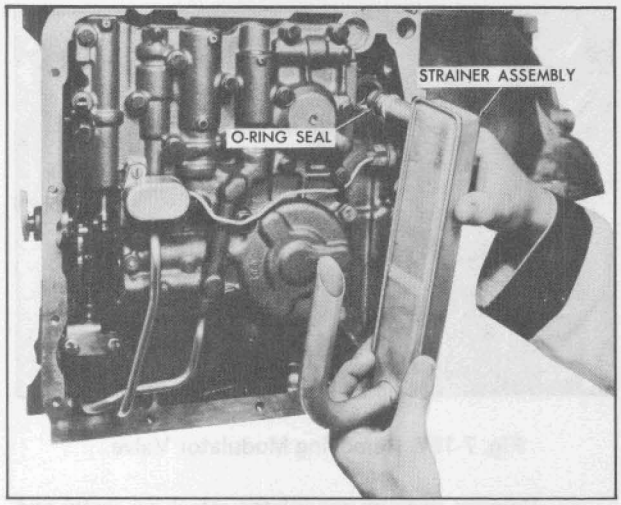


Fig. 7-159 Removing Intake Pipe and Filter Assembly

29c. Remove Speedometer Driven Gear and Speed Controlled Spark Switch Assembly

(NOTE: Unit may be removed without removing transmission from car or without removing governor assembly.)

1. Remove wire attached to speed controlled spark switch.
2. Separate speed controlled spark switch from speedometer driven gear and sleeve assembly by unscrewing.
3. Remove attaching screw and retainer from left side of case. Apply slight pressure to remove sleeve and speedometer driven gear.
4. Remove and discard O-ring from speedometer driven gear assembly.

29d. Remove Intake Pipe and Filter Assembly and Bottom Pan

(NOTE: Units may be removed with transmission in car. In cases of transmission failure, intake pipe and filter must be replaced.)

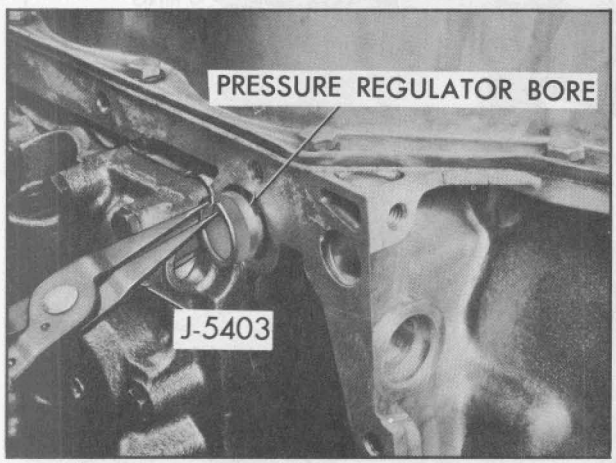


Fig. 7-160 Removing Pressure Regulator Valve

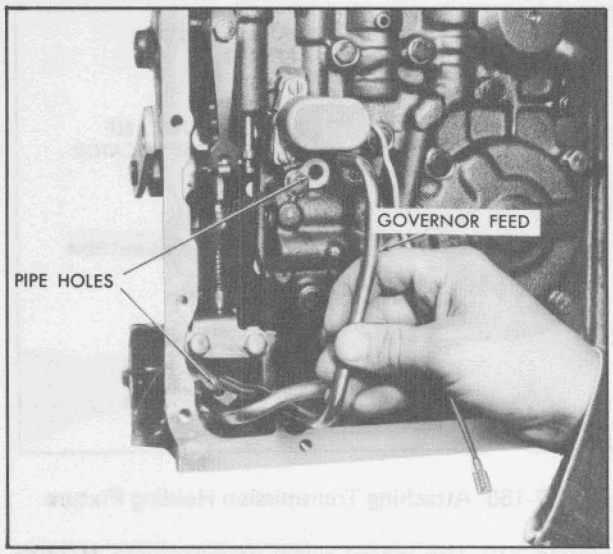


Fig. 7-161 Removing Governor Feed Pipes

1. Rotate transmission and Holding Fixture in Holding Fixture Base so that transmission bottom pan is up. Position container to catch any fluid which may drain from transmission.
2. Remove 13 bottom pan attaching screws.
3. Remove bottom pan and gasket, discarding gasket.
4. Lift out intake pipe and filter assembly, Fig. 7-159.
5. Remove and discard intake pipe O-ring, Fig. 7-159.

29e. Remove Pressure Regulator Valve

(NOTE: Unit may be removed with transmission in car after removing bottom pan.)

1. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring using Snap Ring Pliers, J-5403 (#21), Fig. 7-160.

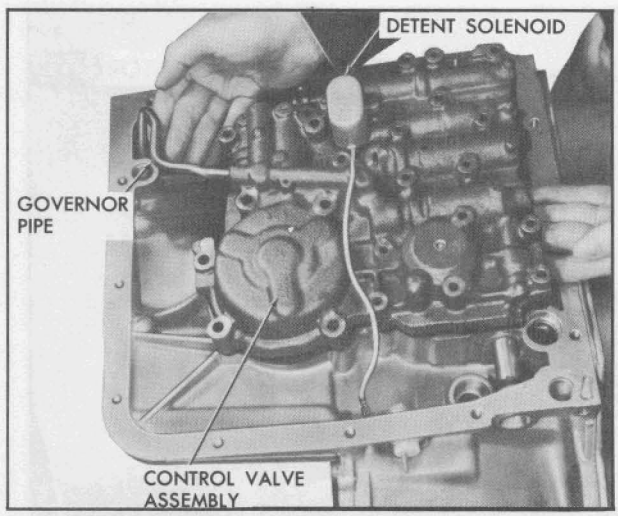


Fig. 7-162 Removing Control Valve Assembly

WARNING: PRESSURE REGULATOR SPRING IS UNDER EXTREME PRESSURE.

2. Remove regulator boost valve bushing and valve.
3. Remove pressure regulator spring.
4. Remove regulator valve, spring retainer, and spacer or spacers if present.

29f. Remove Control Valve Assembly, Governor Pipes, Detent Spring and Roller Assembly, and Check Balls

(NOTE: Units may be removed with transmission in car, after removing bottom pan.)

1. Remove attaching screw and remove detent roller and spring assembly.
2. Disconnect detent wire from case connector.
3. Remove governor feed pipe from transmission case and valve body by lifting straight out, Fig. 7-161.
4. Remove nineteen remaining control valve assembly attaching screws. Do not remove detent solenoid attaching screws at this time.

(NOTE: If the transmission is in the vehicle, the front servo piston assembly may drop down as the control valve assembly and governor pipe are removed.)

5. Remove control valve assembly with remaining governor pipe attached, Fig. 7-162.

CAUTION: Do not allow manual valve to fall out of its bore in control valve assembly.

6. Remove remaining governor pipe from valve body.
7. Remove control valve assembly to spacer gasket.
8. Remove control valve spacer and spacer-to-transmission case gasket, Fig. 7-163.

CAUTION: If control valve is removed in car, seven check balls will come down with spacer.

9. Remove seven check balls from cored passages in transmission case.

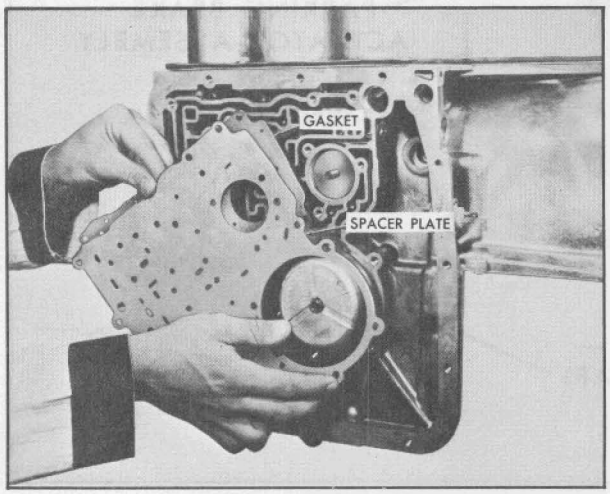


Fig. 7-163 Removing Control Valve Spacer and Gasket

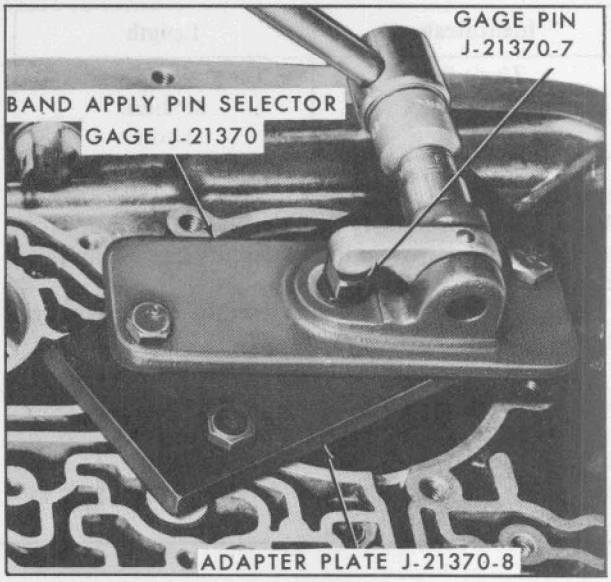


Fig. 7-164 Band Apply Pin Selection Check

(NOTE: The eighth check ball is held in by a retainer and should not be removed unless replacement is required.)

29g. Remove Front Servo Piston and Rear Servo Piston

(NOTE: Units may be removed with transmission in car after removing bottom pan and control valve assembly.)

1. Lift front servo piston retainer ring, pin, spring retainer and spring out of transmission case, Fig. 7-163.
2. Remove rear servo assembly from transmission case, Fig. 7-163.
3. Remove rear servo accumulator spring.
4. Make band apply pin selection check to determine proper size pin to use at time rear servo is assembled. Proceed as described in Step h.

29h. Band Apply Pin Selection Check (Fig. 7-164)

(NOTE: Check may be made with transmission in car. Remove bottom pan, control valve assembly, and rear servo.)

1. Position Adapter Plate, J-21370-8, on transmission case over rear servo bore, and, using screws provided with Adapter Plate, attach Band Apply Pin Selector Gage, J-21370 to Adapter Plate.
2. Position Band Apply Pin Selector Gage, J-21370, with hex nut on side of gage facing toward converter housing, and smaller diameter end of Gage Pin, J-21370-7, in servo pin bore.
3. Secure Adapter Plate to transmission case with two 5/16-18 x 1 inch screws, tightening screws to 18 foot-pounds and secure Selector Gage to Adapter Plate,

Identification	Length
Three Rings	Long
Two Rings	Medium
One Ring	Short

tighten attaching screws to 18 foot-pounds. Make certain that stepped gage pin is free to move up and down in both tool and servo pin bore. Stepped side of pin must face rear of transmission case.

Band apply pins are available in three sizes as shown in the following chart:

Identification ring is located on band lug end of pin. Selecting the proper pin is equivalent to adjusting band.

4. To determine proper size pin to use, apply 25 foot-pounds torque on hex nut on side of gage. This will cause lever on top of gage to depress stepped gage pin into servo pin bore, simulating actual operating conditions. Note relation of steps on gage pin and machined surface on top of gage. Determine proper size pin as follows:

a. If machined surface on top of gage is even with or above upper step on gage pin, long size pin (three rings) is required.

c. If machined surface on top of gage is even with or below lower step on gage pin, short size pin (one ring) is required.

5. If new pin is required, make note of pin size required, and remove gage from transmission case.

29i. Remove Detent Lever, Manual Shaft, and Parking Linkage (Fig. 7-165)

(NOTE: Units may be removed with transmission

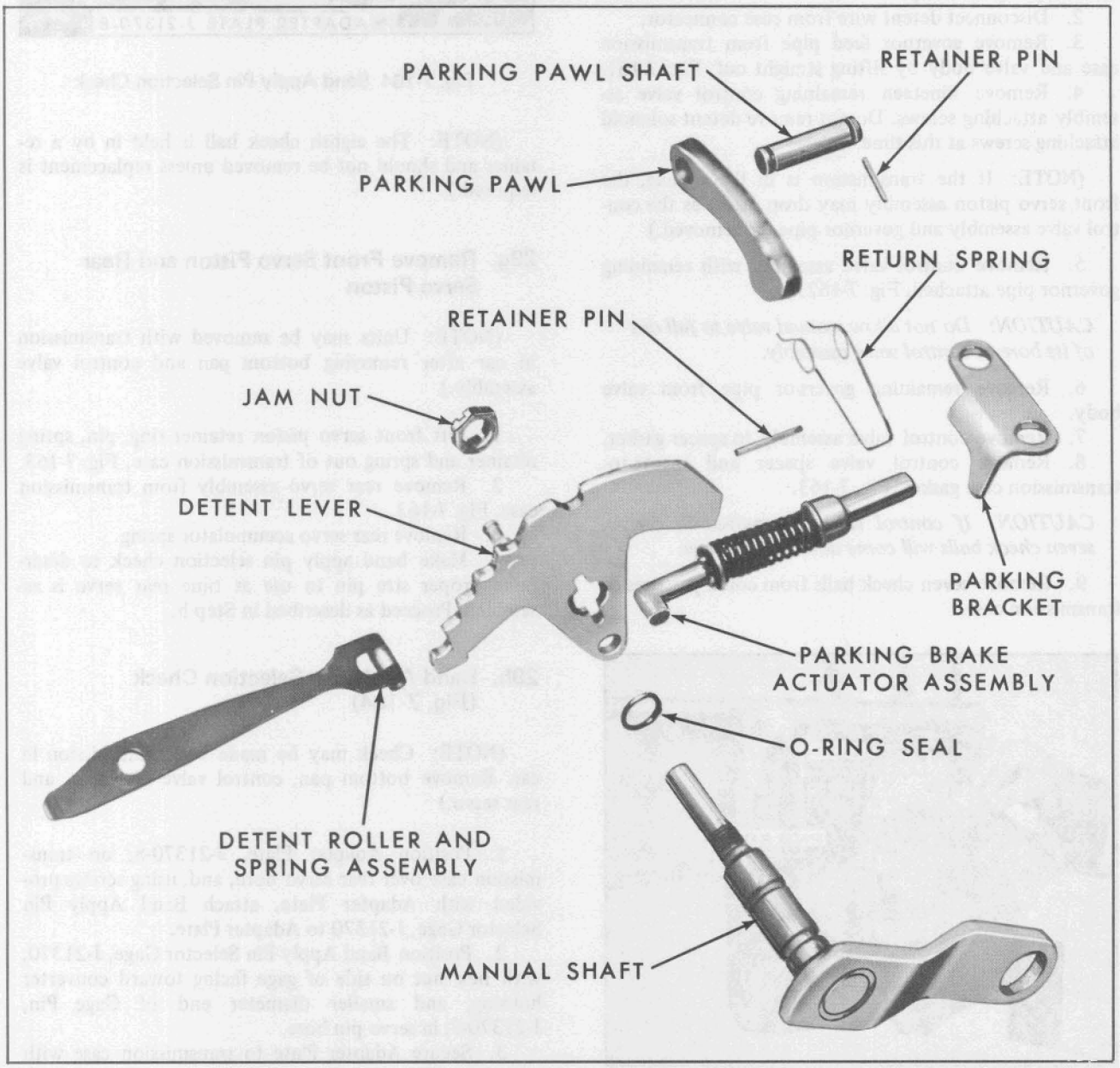


Fig. 7-165 Manual and Parking Linkage Exploded View

in car after removing bottom pan and detent roller and spring assembly from control valve assembly.)

1. Remove pin securing manual shaft to case by pulling straight out.
2. Loosen locknut securing detent lever to manual shaft.
3. Pry or work detent lever loose from ground flats on manual shaft.
4. Remove manual shaft from case bore and remove and discard O-ring seal from manual shaft.

(NOTE: Be careful not to drop jam nut inside of case.)

5. Remove detent lever and parking brake actuator assembly from case and remove actuator assembly from detent lever.
6. Remove parking brake bracket attaching screws and remove bracket.
7. Remove retainer pin securing parking pawl shaft to transmission case by pulling straight out.
8. Remove parking pawl shaft, parking pawl and return spring.

29j. Remove Sprocket Cover, Link Assembly, Drive and Driven Sprockets

1. Rotate transmission in holding fixture base so that sprocket cover is up and remove eighteen cover attaching screws.
2. Remove cover and gasket and discard gasket.
3. Install Snap Ring Pliers, J-4646, into sprocket bearing retaining snap rings located under the drive and driven sprockets, and remove snap rings from retaining grooves on support housing, Fig. 7-166.

(NOTE: Leave snap rings in a loose position between sprockets and bearing assemblies.)

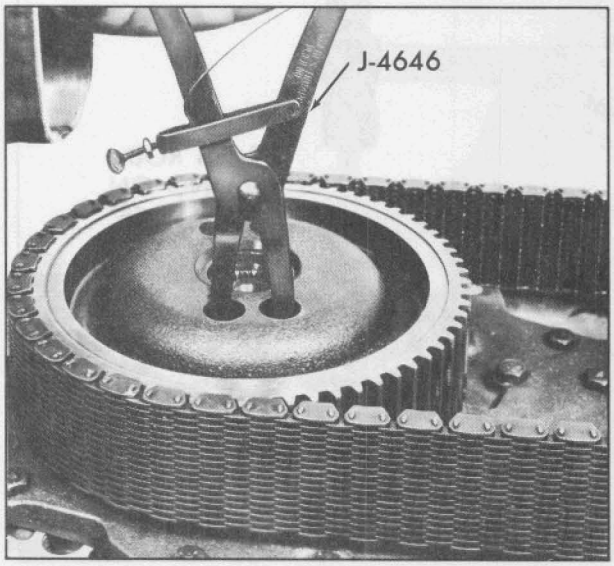


Fig. 7-166 Removing Sprocket Snap Ring

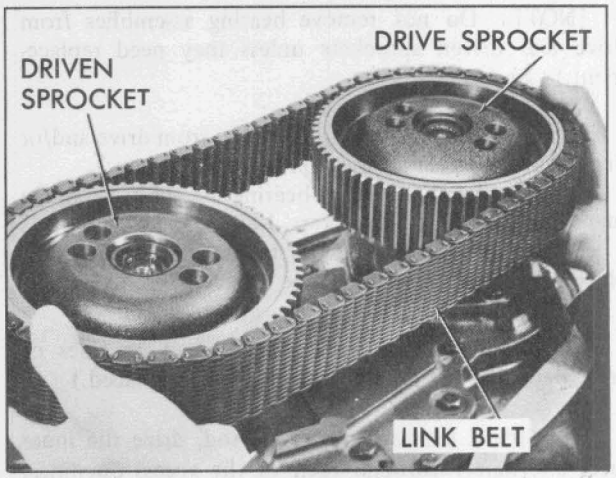


Fig. 7-167 Removing Sprocket and Link Assembly

4. Remove drive and driven sprockets, link assembly, bearings, and shafts simultaneously by alternately pulling upwards on the drive and driven sprockets until the bearings are out of the drive and driven support housings, Fig. 7-167.

(NOTE: If the sprockets are difficult to remove, place a small piece of masonite, or similar material between the sprocket and sprocket support cover. Using a 1/2 x 9 inch pry bar, alternately pry upward under each sprocket on sprocket support cover. Do not pry on the guide links or the aluminum case. Pry only on the sprockets, Fig. 7-168.)

5. Remove link assembly from drive and driven sprockets.
6. Remove the hook type oil seal ring from turbine shaft.
7. Inspect drive and driven sprocket bearing assemblies for rough or defective bearings.

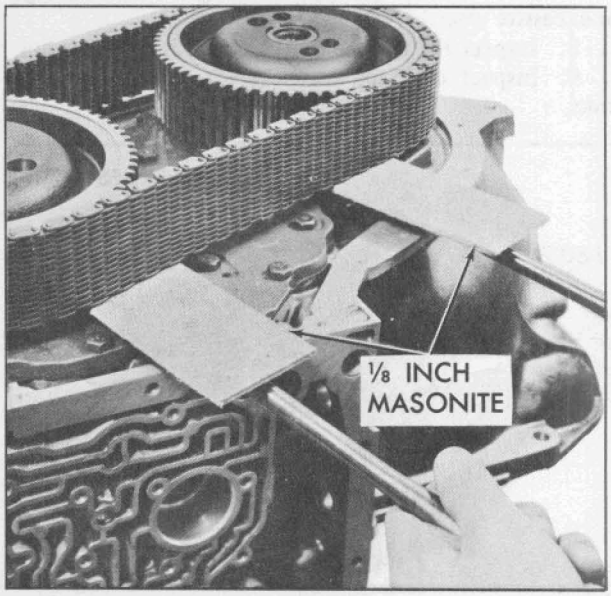


Fig. 7-168 Removing Tight Sprockets

(NOTE: Do not remove bearing assemblies from drive and driven sprockets unless they need replacement.)

8. If removal of bearing assembly from drive and/or driven sprockets is necessary, proceed as follows:

a. Remove sprocket to bearing assembly retaining snap ring using Snap Ring Pliers, J-8059, Fig. 7-169.

b. Mount sprocket, with turbine or input shaft placed down between two 2" x 4" x 10" wood blocks.

(NOTE: Wood blocks are positioned on sides or ends, depending on which bearing is to be replaced.)

c. With a hammer and brass rod, drive the inner race, alternately through each of the access openings, until the bearing assembly is removed from the sprocket hub, Fig. 7-170.

29k. Inspect Drive Sprocket and Turbine Shaft, and Link Assembly

1. Inspect drive sprocket teeth for nicks, burrs, scoring, galling, and excessive wear.

(NOTE: Wear pattern at bottom of tooth form is normal.)

2. Inspect drive sprocket to ball bearing retaining snap ring for damage.

3. Inspect drive sprocket ball bearing inner race mounting surface for damage.

4. Inspect turbine shaft for open lubrication passages. Run a tag wire through the passages to be sure they are open. See lubrication chart for passage location, Fig. 7-144.

5. Inspect spline for damage.

6. Inspect the ground bushing journals for damage.

7. Inspect the hook type oil seal groove for damage or excessive wear.

8. Inspect the turbine shaft for cracks or distortion.

9. Inspect the link assembly for damage or loose links.

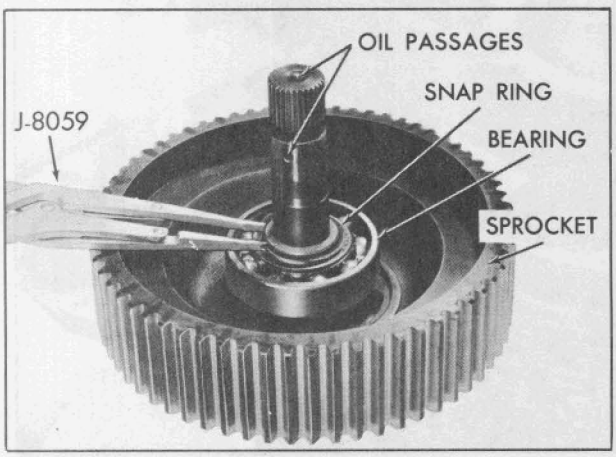


Fig. 7-169 Removing Sprocket Bearing Snap Ring

(NOTE: Check the guide links. Guide links are the wide outside links on each side of the link assembly.)

29l. Inspect Driven Sprocket and Input Shaft

1. Inspect driven sprocket teeth for nicks, burrs, scoring, galling, and excessive wear.

(NOTE: Wear pattern at bottom of tooth form is normal.)

2. Inspect sprocket to ball bearing retaining snap ring for damage.

3. Inspect ball bearing inner race mounting surface for damage.

4. Inspect input shaft for open lubrication holes. Run a tag wire through the holes to be sure they are open. See Fig. 7-144 for location of holes.

5. Inspect spline for damage.

6. Inspect ground bushing journal for damage.

29m. Install Sprocket Bearings

1. Turn sprocket so that turbine or input shaft is pointing upward.

2. Install new sprocket bearing as follows:

a. Install support snap ring, letter side down onto shaft.

b. Assemble bearing assembly on turbine or input shaft.

c. Using a piece of pipe, drive the bearing assembly onto the hub of the sprocket until it is resting on the bearing seat of the sprocket.

CAUTION: Use pipe that closely fits I.D. of bearing assembly but does not contact shaft.

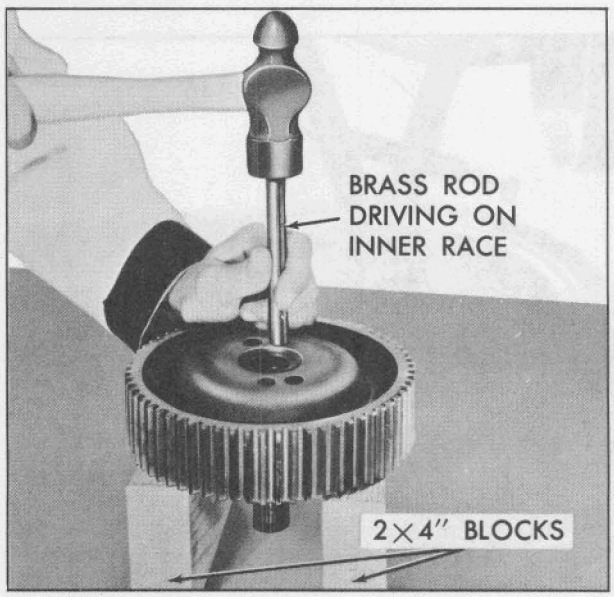


Fig. 7-170 Removing Sprocket Bearing

d. Install sprocket to bearing assembly retaining snap ring into groove in sprocket hub.

3. Install hook type oil seal ring on turbine shaft.

(NOTE: Turbine and/or input shaft may appear not to be pressed fully into the sprocket. Do not attempt pressing shaft further as a specific length dimension is held during initial assembly.)

29n. Front Unit End Play Check

1. Install Front Unit End Play Checking Tool, J-22241, into driven sprocket housing so that the urethane on the tool can engage the splines in the forward clutch housing. Let the tool bottom on the mainshaft and then withdraw it approximately 1/8 inch and tighten nut on tool, Fig. 7-171.

2. Remove one bolt from the driven support housing, and install Slide Hammer Bolt, J-6125-1, into bolt hole in driven support housing.

(NOTE: Do not thread slide hammer bolt deep enough to interfere with forward clutch housing travel.)

3. Mount Dial Indicator, J-8001, on slide hammer bolt and index indicator to register with the Front Unit End Play Checking Tool, J-22241, Fig. 7-171 and push tool down to remove slack.

4. Push and hold output flange upward. Place a screw driver in case opening at parking pawl area and push upward on output carrier.

5. Place another screw driver between the metal lip of the end play tool and the driven sprocket housing and push upward on the metal lip of the end play tool and read the resulting end play, which should be between .003" and .024".

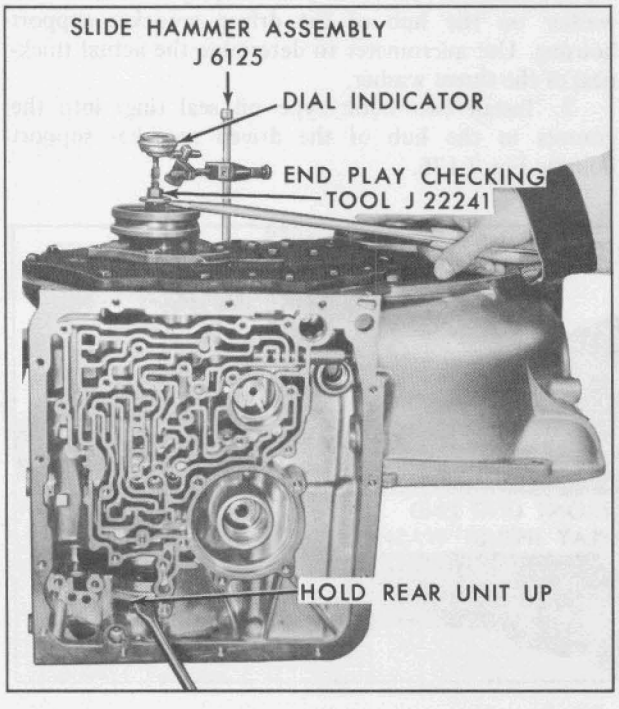


Fig. 7-171 Checking Front Unit End Play

The selective washer controlling this end play is the thrust washer located between the driven support housing and the forward clutch housing. If more or less washer thickness is required to bring the end play within specifications, select the proper washer from the chart below:

THICKNESS	COLOR
.060-.064	Yellow
.071-.075	Blue
.082-.086	Red
.093-.097	Brown
.104-.108	Green
.115-.119	Black
.126-.130	Purple

(NOTE: An oil soaked washer may tend to discolor so that it will be necessary to measure the washer with a set of one inch micrometers to determine its actual thickness.)

6. Remove end play tool from transmission and remove dial indicator and slide hammer bolt from transmission.

29o. Remove Oil Pump

1. Remove two opposite pump attaching bolts from the drive support housing.

2. Install two 5/16-18 x 4" guide pins in holes from previously removed bolts.

3. Remove the remaining pump attaching bolts from the drive support housing.

4. With one hand hold the underside of the pump and gently tap the guide pins until the pump is removed from the case.

29p. Remove Pump Cover Plate, Converter Out Check Valve and Drive and Driven Support Housing Assemblies

1. Remove the twenty-three pump cover plate-to-case attaching screws and remove pump cover plate. Do not remove sprocket support housing bolts at this time.

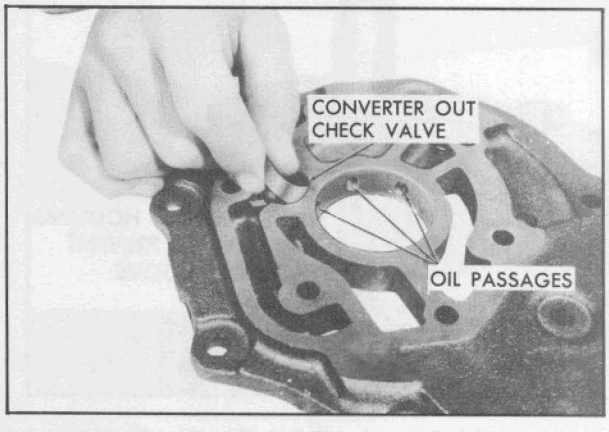


Fig. 7-172 Removing or Installing Check Valve

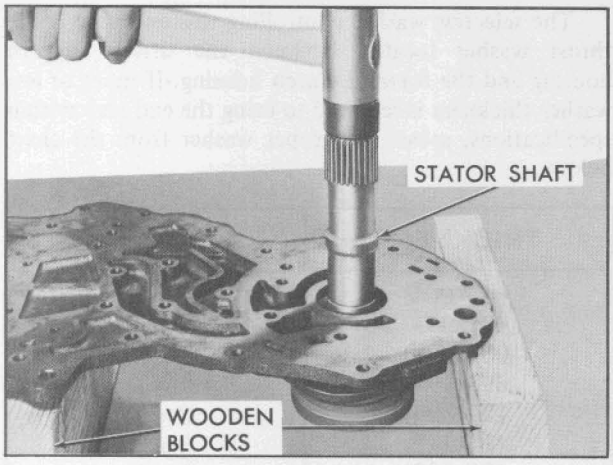


Fig. 7-173 Removing Drive Sprocket Support

2. Remove pump cover plate and plate-to-case face gasket. Discard gasket.

(NOTE: Drive and driven support housing assemblies are pressed into and removed with the pump cover plate. Do not remove them unless it is necessary.)

3. Remove two hook type oil seal rings from the driven support housing.

4. Remove the front unit end play selective thrust washer from the hub of the driven support housing.

5. If necessary to remove the drive and driven sprocket support housing assemblies, proceed as follows:

a. Remove the remaining sprocket support to pump cover plate attaching bolts.

b. Support cover plate on wooden blocks and using a plastic mallet, vigorously strike the stator shaft of the drive sprocket support, Fig. 7-173, and the hub of the driven sprocket support, Fig. 7-174, until they are removed from their pump cover plate bores.

CAUTION: When driving the housings out of the pump cover plate avoid damaging or distorting the stator shaft or the ring grooves in the hub of the driven housing.

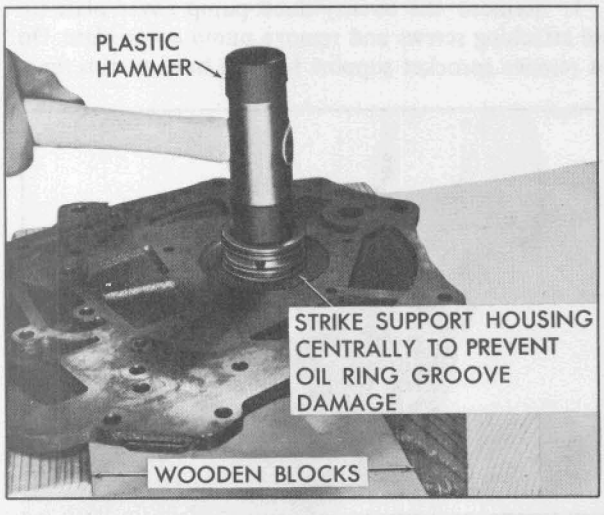


Fig. 7-174 Removing Driven Sprocket Support

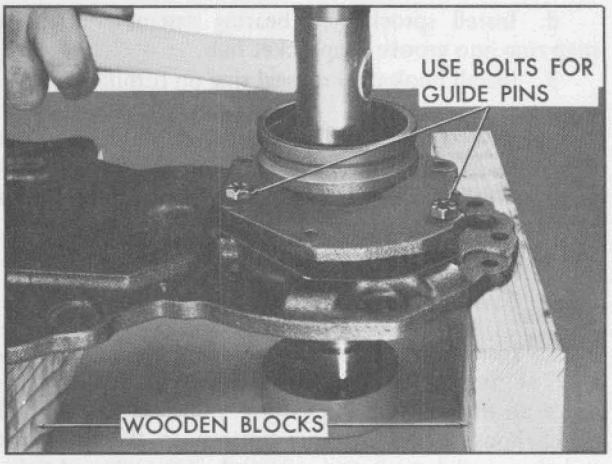


Fig. 7-175 Installing Driven Sprocket Support

c. Remove and discard housing to pump cover plate gaskets.

d. Remove converter out check valve, Fig. 7-172.

e. Install converter out check valve.

f. Install drive sprocket support housing to pump cover plate gasket.

g. Install drive sprocket support housing into pump cover plate by using a plastic mallet to seat the housing. Use bolts for guides, Fig. 7-175.

h. Install driven sprocket support housing to pump cover plate gasket.

i. Install driven sprocket support housing to pump cover plate attaching bolts for gasket guides.

j. Install driven sprocket support housing into pump cover plate by using a plastic mallet to seat the housing.

k. Install all but one driven support housing to pump cover plate attaching bolts. Torque to 20 ft. lbs.

6. Install proper front unit end play selective thrust washer on the hub of the driven sprocket support housing. Use micrometer to determine the actual thickness of the thrust washer.

7. Install two hook type oil seal rings into the grooves in the hub of the driven sprocket support housing Fig. 7-176.

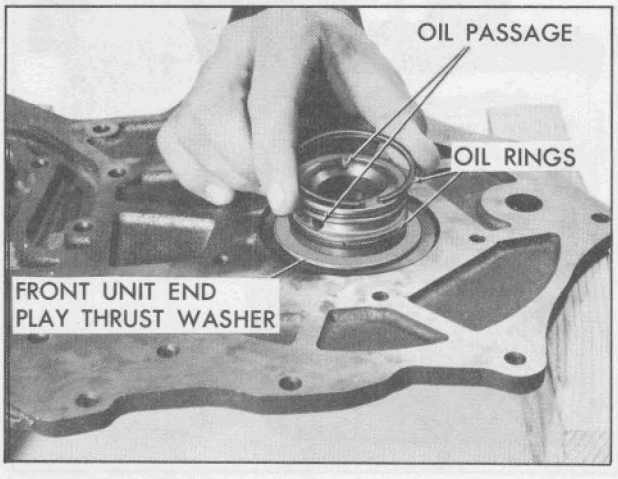


Fig. 7-176 Installing O-Rings on Sprocket Support

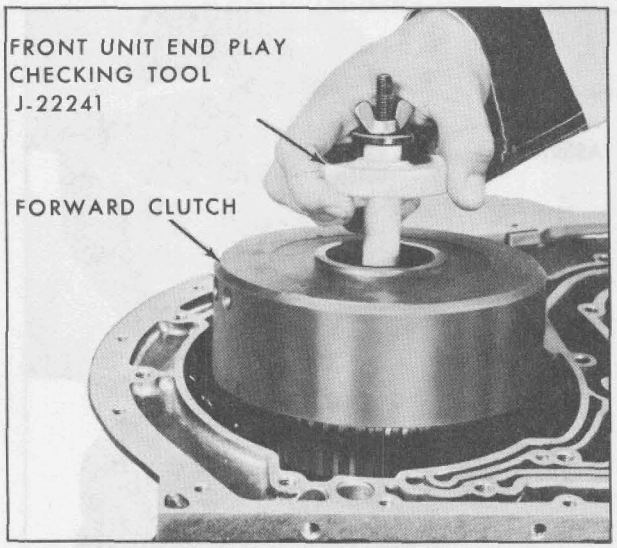


Fig. 7-177 Removing Forward Clutch

29q. Remove Forward Clutch Assembly, Direct Clutch Assembly, Sun Gear Shaft, and Front Band

1. Remove forward clutch assembly from transmission, Fig. 7-177, by installing Front End Play Checking Tool, J-22241, into forward clutch and lifting forward clutch straight out.
2. Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with forward clutch assembly.
3. Remove direct clutch and intermediate sprag assembly by lifting straight out. Sun gear shaft may come out with direct clutch assembly.
4. Remove sun gear shaft if not previously removed.
5. Remove front band assembly.

(NOTE: Check rear unit end play at this time. Proceed as described in Step r.)

29r. Rear Unit End Play Checking Procedure

1. Rotate transmission in holding fixture base so that forward end of transmission is up.

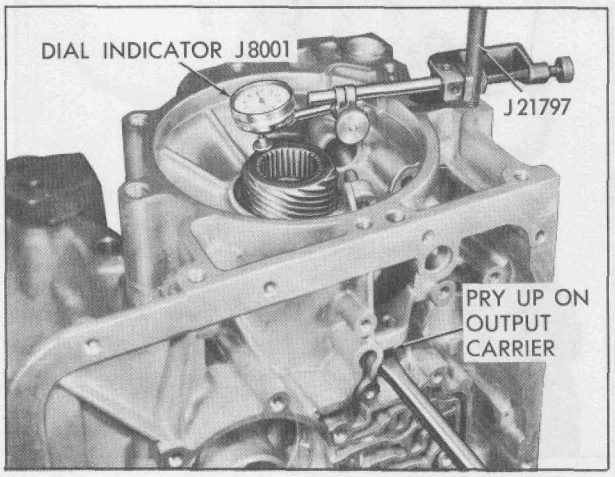


Fig. 7-178 Checking Rear Unit End Play

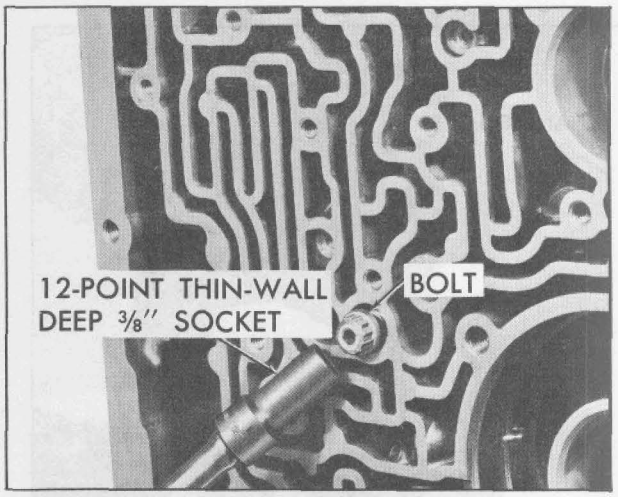


Fig. 7-179 Removing Center Support Bolt

2. Install Speedometer Puller Bolt, J-21797, in one of the differential mounting bolt holes on end of transmission case.
3. Mount Dial Indicator, J-8001, on Bolt J-21797, and index indicator to register with flat surface on end of output flange, Fig. 7-178.
4. Set dial indicator to zero.
5. Using a screw driver, move output flange in and out. Note resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .007 inch - .019 inch.

The selective washer controlling this end play is the steel washer with the three tabs, located between thrust washer and rear face of transmission case. Notches and/or numerals on the tabs serve to identify washer thickness.

If a different washer thickness is required to bring end play within specifications, it can be selected from the following chart. The tabs will show identification notches, numerals or both.

Thickness	Identification Notch and/or Numeral	
.074 - .078	None	1
.082 - .086	On Side of 1 Tab	2
.090 - .094	On Side of 2 Tabs	3
.098 - .102	On End of 1 Tab	4
.106 - .110	On End of 2 Tabs	5
.114 - .118	On End of 3 Tabs	6

6. Remove Dial Indicator, J-8001, and Bolt, J-21797, from transmission and rotate transmission so that rear end of transmission is up.

29s. Remove Remaining Components

1. Remove center support bolt from transmission case, Fig. 7-179, using a 3/8 inch 12-point thin wall deep socket.



Fig. 7-180 Removing Gear Unit Assembly

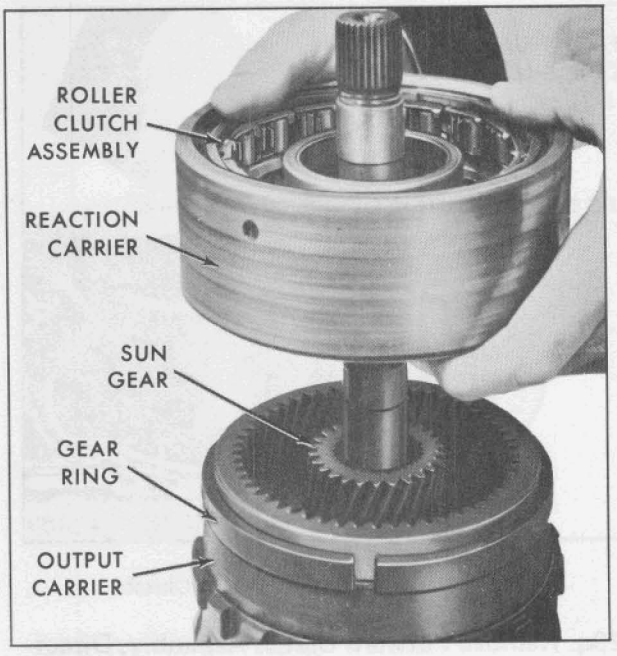


Fig. 7-181 Removing Reaction Carrier and Roller Clutch

2. Remove intermediate clutch backing plate to case snap ring.

3. Remove intermediate clutch backing plate, and three composition and three steel clutch plates.

4. Using a needle-nose pliers, or screwdriver, remove center support to case snap ring.

5. Install Gear Assembly Remove and Installer Adapter, J-21795, on end of main shaft so that tangs engage groove in shaft. Using Slide Hammer Handle, J-6125, and Speedometer Puller Bolt, J-21797, tighten bolt on tool to secure tool on shaft, Fig. 7-180.

6. Remove complete gear unit assembly from case, by lifting straight up.

CAUTION: Be careful not to drop or bump assembly in transmission case during removal.

7. Remove output flange to case thrust washer from output flange or case.

8. Place gear unit assembly on bench with output flange down. Remove Tool J-21795.

9. Remove support to case spacer (Fig. 7-198).

10. Remove rear band assembly. To facilitate removal, rotate band lugs away from pins and pull band assembly out of transmission case.

11. Remove rear unit selective washer from transmission case.

30. Individual Unit Disassembly, Cleaning, Inspection, Assembly and Installation of Major Components

30a. Inspection of Transmission Case

1. Inspect case assembly for cracks, porosity or interconnected passages, Fig. 7-145.

2. Check for good retention of band anchor pins.

3. Inspect all threaded holes for thread damage.

4. Inspect intermediate clutch driven plate lugs for damage or brinelling.

5. Inspect snap ring grooves for damage.

6. Inspect governor assembly bore for scratches or scoring.

7. Inspect governor pipes screen assemblies (located in governor pipe holes in case) for plugging or damage.

8. Inspect modulator valve bore for scoring or damage.

9. Inspect output flange bushing for wear, galling and open lubrication groove.

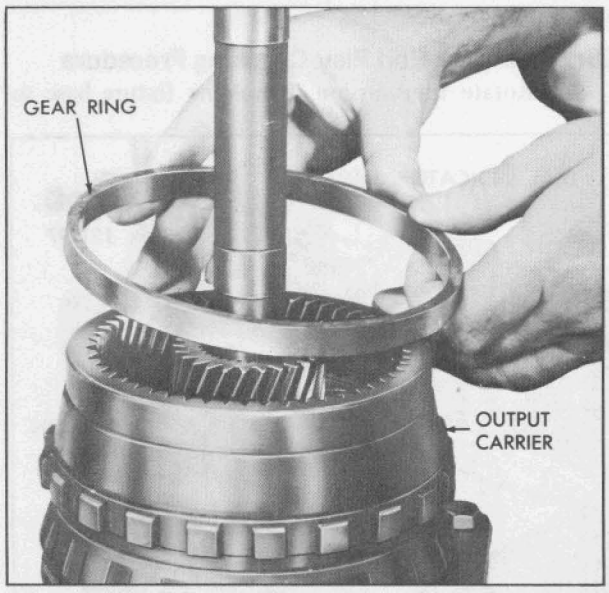


Fig. 7-182 Removing Front Internal Gear Ring

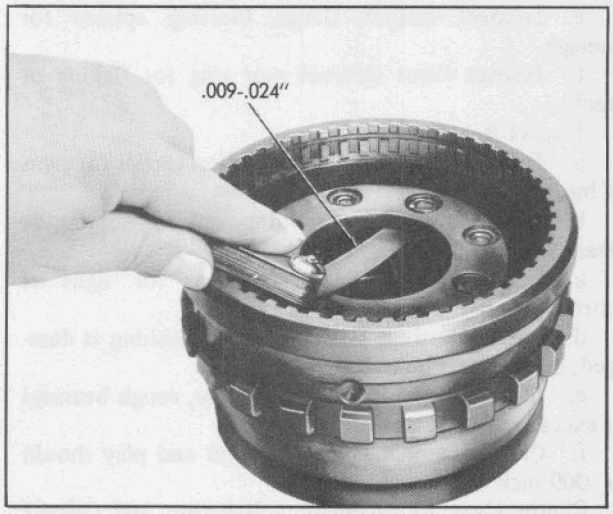


Fig. 7-183 Checking Pinion End Play

30b. Center Support and Gear Unit

1. Disassembly
   a. Remove center support assembly from reaction carrier by lifting center support straight up.
   b. Remove center support to reaction carrier thrust washer.

(NOTE: Thrust washer may have stuck to back of center support. If so, remove from center support.)

   c. Remove reaction carrier and roller clutch assembly from output carrier, Fig. 7-181, and remove roller clutch assembly from reaction carrier.
   d. Remove center support to sun gear races and thrust bearing from sun gear.

(NOTE: One of the races may have stuck to back of center support.)

   e. Remove front internal gear ring from output carrier assembly, Fig. 7-182.
   f. Remove sun gear from output carrier assembly.
   g. Remove reaction carrier to output carrier plastic thrust washer from output carrier.
   h. Invert gear unit and place in Rear Unit Holding Fixture, J-6116, with main shaft pointing downward.
   i. Remove snap ring securing output flange to output carrier and remove output flange.
   j. Remove thrust bearing and races from rear internal gear.
   k. Lift rear internal gear and main shaft out of output carrier and remove thrust bearing and races from inner face of rear internal gear.
   l. Remove snap ring from end of main shaft and remove rear internal gear.
   m. Remove output carrier from holding fixture.
2. Inspect Output Flange
   a. Inspect bearing and thrust washer surfaces for damage.
   b. Inspect drive lugs for damage.
   c. Inspect splines for damage.
   d. Inspect lubrication passages.
3. Inspect Main Shaft
   a. Inspect shaft for cracks or distortion.
   b. Inspect splines for damage.
   c. Inspect ground bushing journals for damage.
   d. Inspect snap ring groove for damage.
   e. Inspect lubrication passages.
4. Inspect Rear Internal Gear
   a. Inspect gear teeth for damage or wear.
   b. Inspect splines for damage.
   c. Inspect gear for cracks.

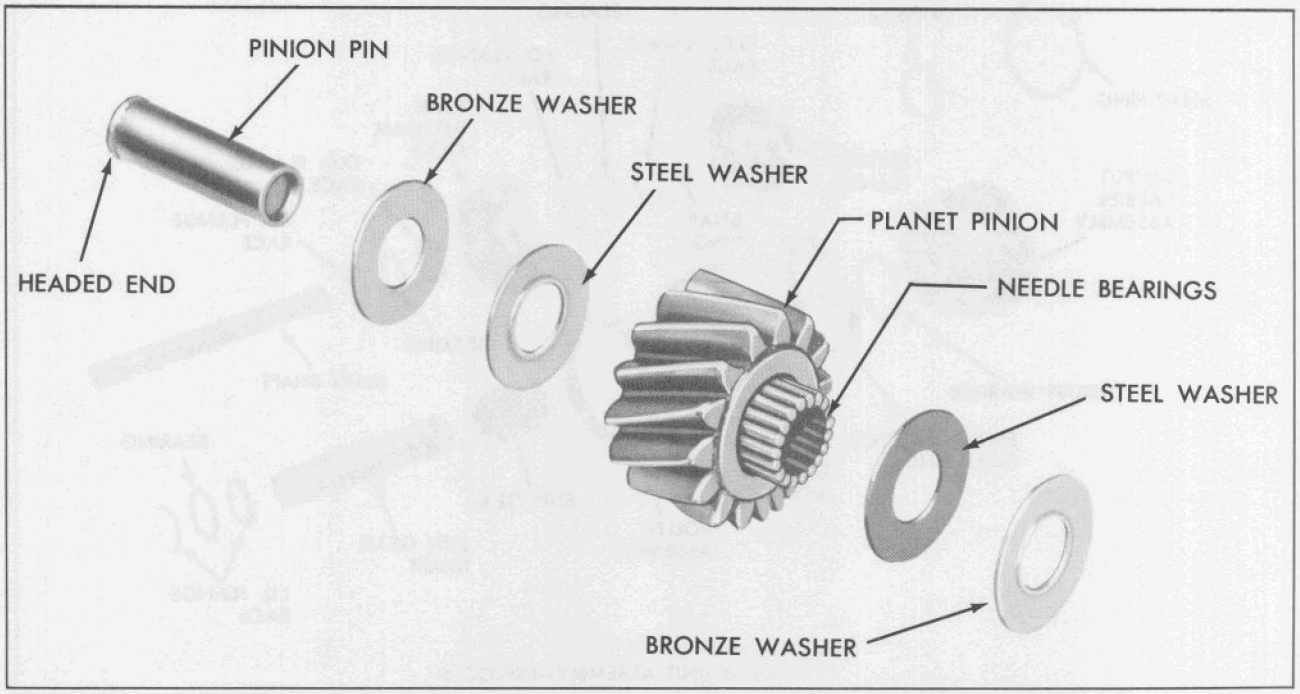


Fig. 7-184 Planet Pinion Exploded View

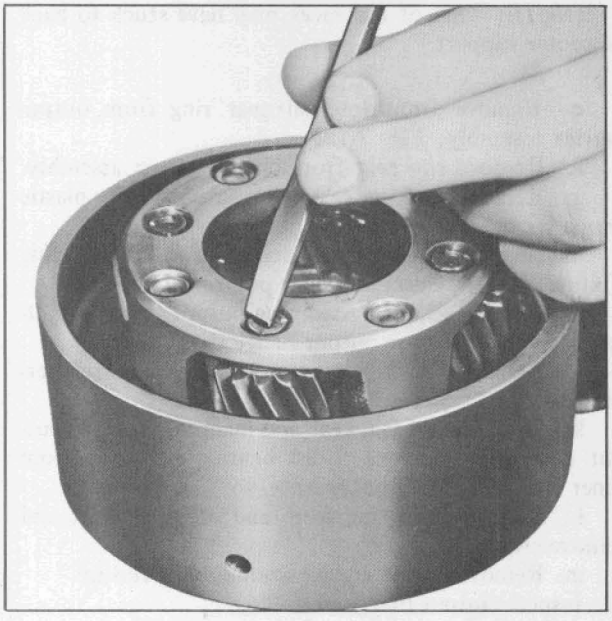


Fig. 7-185 Staking Pinion Pin

d. Inspect bearing and thrust surfaces for wear or galling.

5. Inspect Output Carrier

a. Inspect front internal gear for damaged teeth.

b. Inspect pinion gears for damage, rough bearings or excessive tilt.

c. Check pinion end play. Pinion end play should be .009 inch - .024 inch, Fig. 7-183.

d. Inspect parking gear lugs for cracks or damage.

e. Inspect output flange locating splines for damage.

f. Inspect front internal gear ring for flaking or cracks.

6. Inspect Reaction Carrier

a. Inspect band surface on reaction carrier for signs of burning or scoring.

b. Inspect roller clutch outer cam for scoring or wear.

c. Inspect thrust washer surfaces for signs of scoring or wear.

d. Inspect bushing for damage. If bushing is damaged, carrier must be replaced.

e. Inspect pinion gears for damage, rough bearings or excessive tilt.

f. Check pinion end play. Pinion end play should be .009 inch - .024 inch.

7. Pinion Gear Replacement - Reaction and Output Carrier Assemblies

a. Support carrier assembly on its FRONT face.

b. Using a 1/2 inch diameter drill, remove the stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the probability of cracking the carrier when the pinion pins are pressed out.

CAUTION: Do not allow drill to remove any stock from the carrier, as this will weaken the part, and could cause a failure.

c. Using a tapered punch, drive or press pinion pins out of carrier.

d. Remove pinion gears, thrust washers, and roller needle bearings.

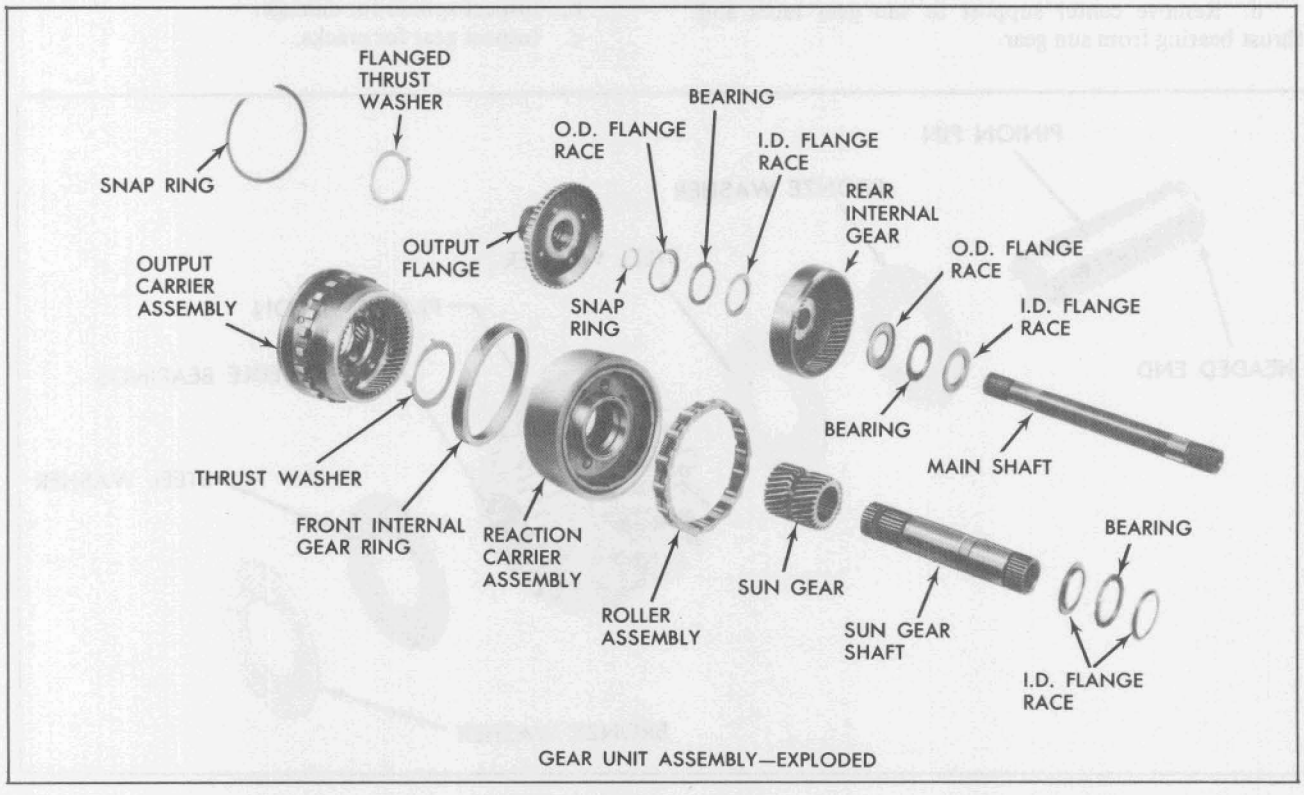


Fig. 7-186 Gear Unit Exploded View

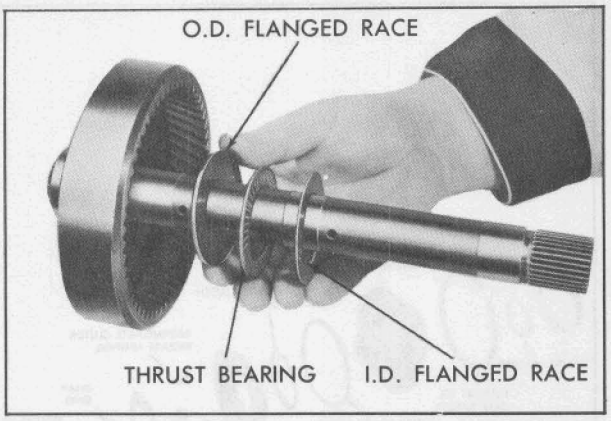


Fig. 7-187 Installing Thrust Bearing on Inner Face of Rear Internal Gear

e. Inspect pinion pocket thrust faces for burrs and remove if present.

f. Install eighteen needle bearings into each pinion gear using petrolatum to hold bearings in place. Use a pinion pin as a guide.

g. Place a bronze and steel thrust washer on each side of pinion gear with steel washers against gear, Fig. 7-184. Hold washers in place with petrolatum.

h. Place pinion gear assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.

i. Drive a new pinion pin into place from the front, while rotating pinion gear. Be sure that headed end is flush or below face of carrier.

j. Using a punch in bench vise for an anvil, stake opposite end of pinion pin in three places with a blunt radius chisel, Fig. 7-185.

(NOTE: Both ends of pinion pins must lie below face of carrier or interference may occur.)

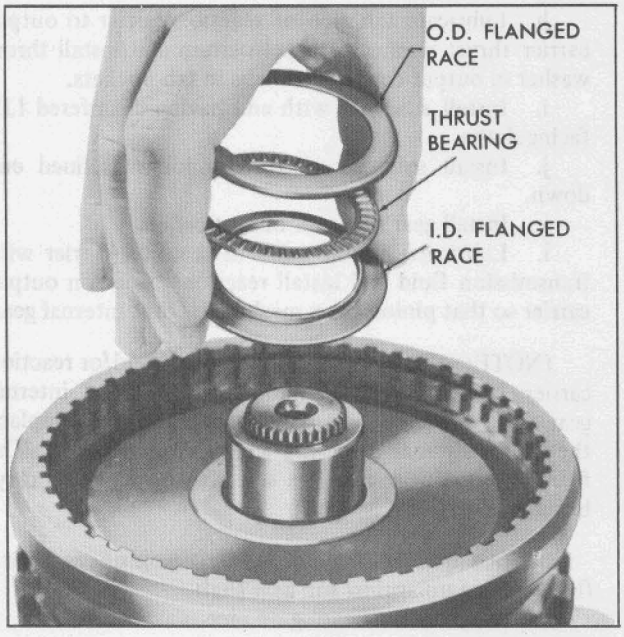


Fig. 7-188 Installing Thrust Bearing on Outer Face of Rear Internal Gear

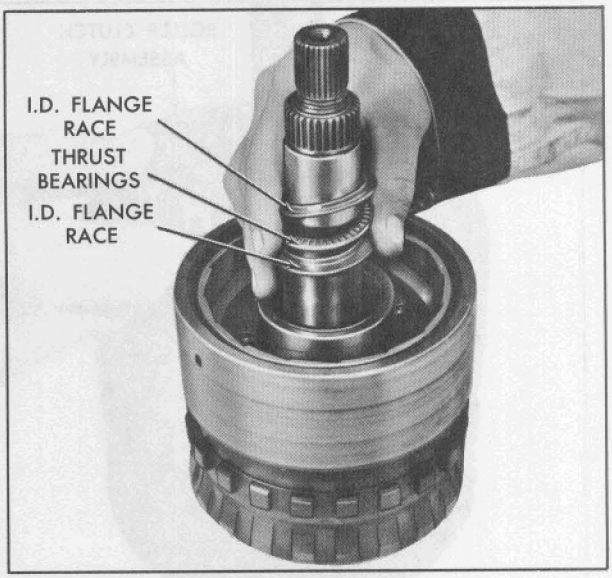


Fig. 7-189 Installing Thrust Bearing Over Sun Gear Shaft

k. Repeat installation procedure for each pinion gear.

8. Inspect Roller Clutch
   a. Inspect roller clutch for damaged rollers or springs.
   b. Inspect roller clutch cage for damage.
9. Inspect Sun Gear
   a. Inspect gear teeth for damage or wear.
   b. Inspect splines for damage.
   c. Be sure oil lubrication hole is open.
10. Inspect Sun Gear Shaft
   a. Inspect shaft for cracks or splits.
   b. Inspect splines for damage.
   c. Inspect bushings for scoring or galling.
   d. Inspect ground bushing journals for damage.

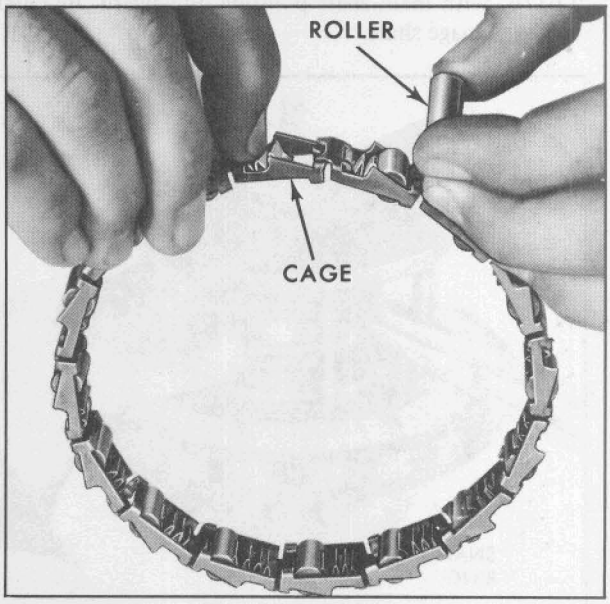


Fig. 7-190 Installing Rollers in Cage

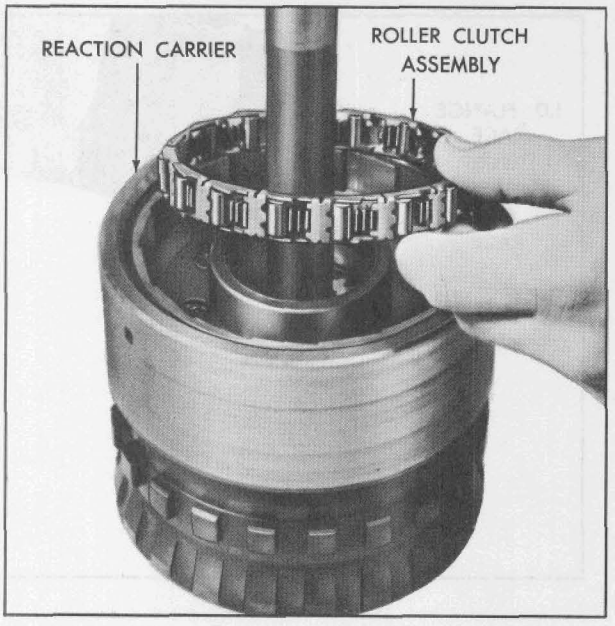


Fig. 7-191 Installing Roller Clutch in Reaction Carrier

e. Be sure oil lubrication hole is open.

11. Assemble Gear Unit (Fig. 7-186)

a. Install rear internal gear on end of main shaft that has snap ring groove and install snap ring.

b. Install races and thrust bearing on inner face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

1. Install large diameter race first, with flange facing up, Fig. 7-187.

2. Install thrust bearing in race.

3. Install small diameter race on bearing with inner flange facing down.

c. Lubricate pinion gears in output carrier with transmission fluid and install output carrier on main shaft so that pinion gears mesh with rear internal gear.

d. Place assembly in a Rear Unit Holding Fixture, J-6116, with main shaft pointing downward. Be careful not to damage shaft.

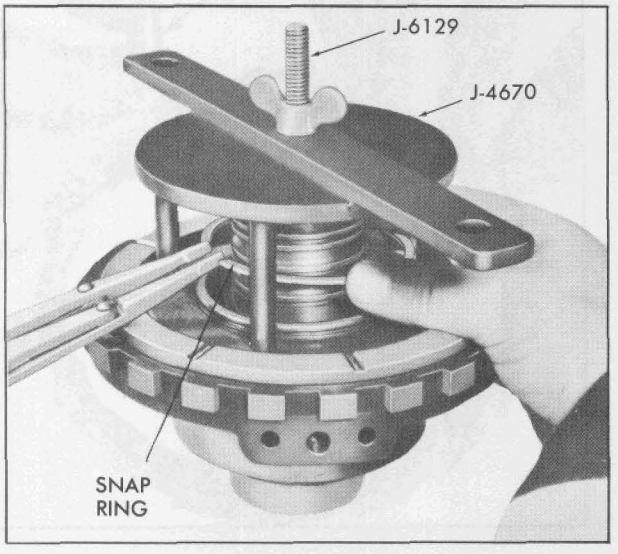


Fig. 7-192 Installing Intermediate Clutch Snap Ring

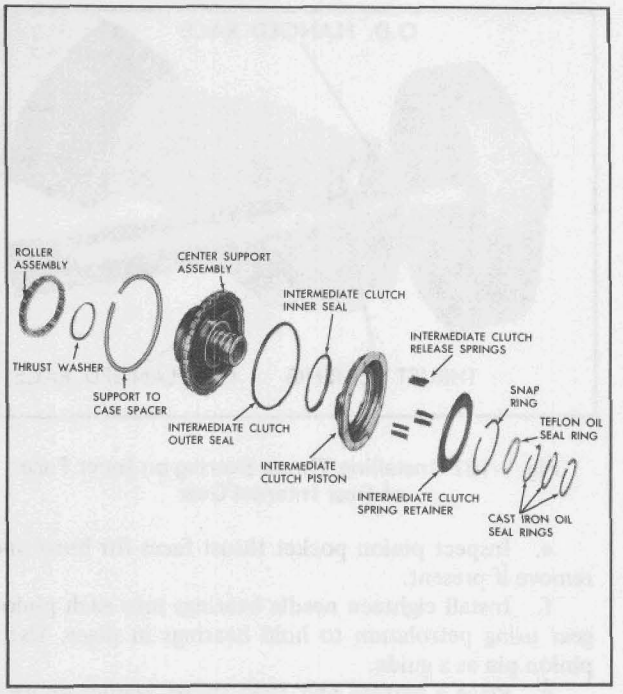


Fig. 7-193 Case Support Assembly – Exploded View

e. Install races and thrust bearing on outer face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

1. Install small diameter (flanged I.D.) race first, with flange facing up, Fig. 7-188.

2. Install thrust bearing in race.

3. Install large diameter (flanged O.D.) race on bearing with flange cupped over bearing.

f. Install output flange into output carrier and install snap ring.

g. Invert assembly and place on bench with output flange downward.

h. Lubricate tab side of reaction carrier to output carrier thrust washer with petrolatum and install thrust washer in output carrier with tabs in tab pockets.

i. Install sun gear with end having chamfered I.D. facing down.

j. Install sun gear shaft with longer splined end down.

k. Install gear ring over output carrier.

l. Lubricate pinion gears in reaction carrier with transmission fluid and install reaction carrier on output carrier so that pinion gears mesh with front internal gear.

(NOTE: When a new output carrier and/or reaction carrier is being installed, and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the service ring. The front internal gear ring is a selective fit at the factory, but not in service.)

m. Install large diameter O.D. race on sun gear with flange facing up against sun gear shaft.

n. Install thrust bearing on race.

o. Lubricate small diameter race with petrolatum and install race on center support with flange facing toward tower end, Fig. 7-189.

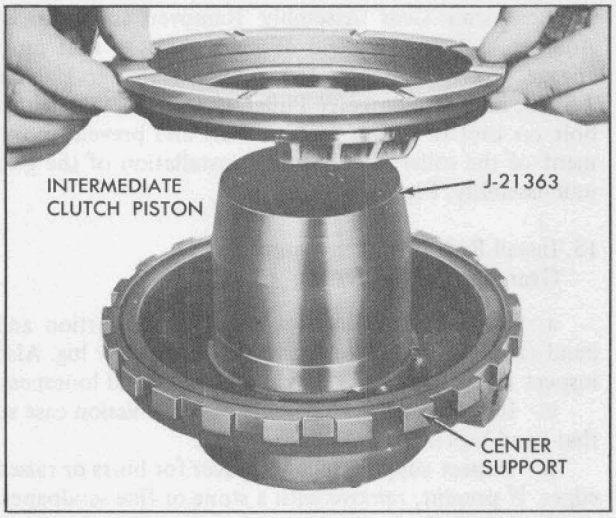


Fig. 7-194 Installing Intermediate Clutch Piston

p. Install rollers that may have come out of roller clutch cage, by compressing energizing spring with forefinger and inserting roller from outer side, Fig. 7-190.

(NOTE: Make certain that energizing springs are not distorted, and that curved end leaf of springs are positioned against rollers.)

q. Install roller clutch assembly in reaction carrier, Fig. 7-191.

12. Disassemble Center Support and Intermediate Clutch Piston

a. Remove center support to reaction carrier thrust washer from recess in center support.

b. Remove three hook type cast iron oil seal rings from the center support. Do not remove the teflon oil seal ring unless replacement is required. All service center support oil seal rings are hook type cast iron.

c. Using Clutch Spring Compressor, J-4670, and Rear Clutch Spring Compressor, J-6129, Fig. 7-192 compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586.

d. Remove tools, spring retainer, and six intermediate clutch release springs.

e. Remove intermediate clutch piston from center support.

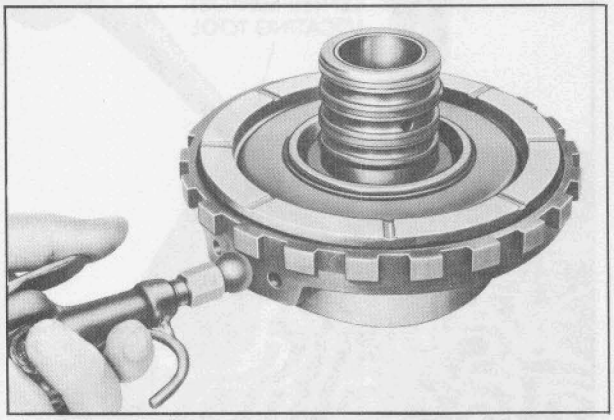


Fig. 7-195 Air Checking Intermediate Clutch



Fig. 7-196 Installing Center Support to Reaction Carrier Thrust Washer

f. Remove inner and outer seals from clutch piston.

(NOTE: Do not remove the three screws retaining roller clutch inner race to center support.)

13. Inspect Center Support

a. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open.

b. Inspect bushing for scoring, wear or galling.

c. Check oil ring grooves for damage.

d. Air check oil passages to be sure they are open and not interconnected.

e. Inspect piston sealing surfaces for scratches.

f. Inspect piston seal grooves for nicks or other damage.

g. Inspect piston for cracks or porosity.

h. Inspect springs for collapsed coils or signs of distortion.

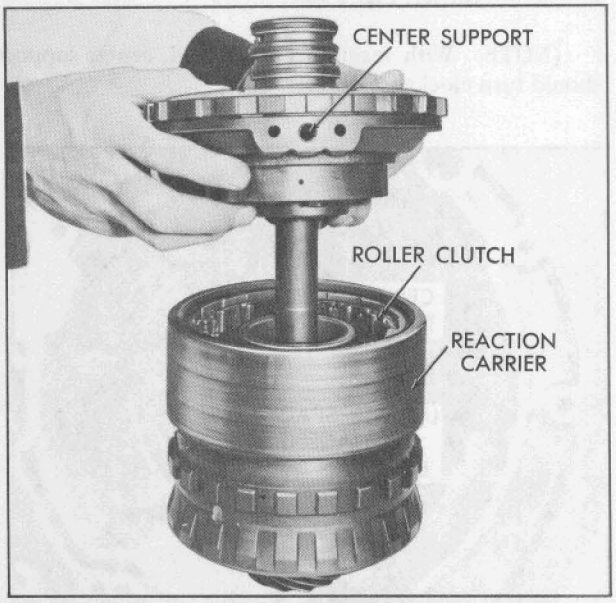


Fig. 7-197 Installing Center Support In Reaction Carrier

(NOTE: The six intermediate clutch release springs are not serviced. If one or more of these spring require replacement, discard all of them and install the 12 service intermediate clutch release springs.)

i. Inspect oil seal rings for damage.

(NOTE: All service center support oil seal rings are hook type cast iron.)

14. Assemble Center Support and Intermediate Clutch Piston Assembly (Fig. 7-193)

a. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in intermediate clutch piston and install seals with lips facing away from spring pockets.

b. Place Intermediate Clutch Inner Seal Protector, J-21363, over center support hub, Fig. 7-194, and install intermediate clutch piston.

c. Install six clutch release springs equally spaced into spring pockets in clutch piston.

d. Place spring retainer and snap ring over springs.

e. Using Clutch Spring Compressor, J-4670, and Rear Clutch Spring Compressor, J-6129, Fig. 7-192, compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586. Remove tools.

f. Install three hook type cast iron oil seal rings on the center support if the teflon ring was not removed. If the teflon ring was removed, install four hook type cast iron oil seal rings.

g. Air check operation of intermediate clutch piston. Apply air through center oil feed hole to actuate clutch piston, Fig. 7-195.

h. Lubricate center support to reaction carrier thrust washer with petrolatum and install washer in recess of center support, Fig. 7-196. Check to make sure sun gear thrust bearing race is on center support.

i. Install center support assembly into roller clutch in reaction carrier, Fig. 7-197.

(NOTE: With reaction carrier held, center support should turn clockwise only.)

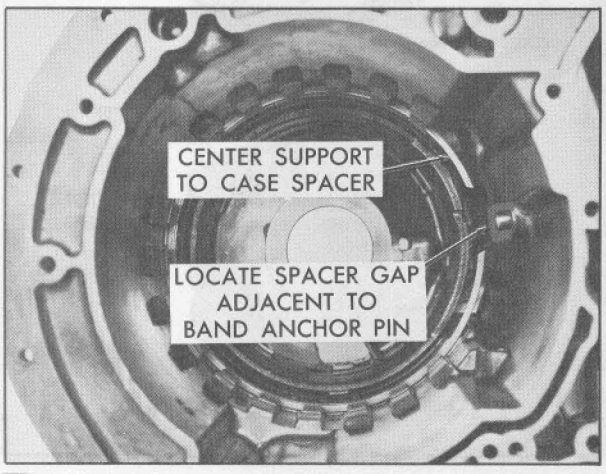


Fig. 7-198 Installing Support to Case Spacer

j. Install Gear Assembly Remover and Installer Adapter, J-21795, on end of main shaft so that tangs engage groove in shaft. Using Slide Hammer Handle, J-6125, and Speedometer Puller Bolt, J-21797, tighten bolt on tool to secure tool on shaft and prevent movement of the roller clutch during installation of the gear unit assembly, Fig. 7-180.

15. Install Rear Band and Complete Gear Unit Assembly

a. Inspect rear band for cracks or distortion and band ends for damage to anchor lugs and apply lug. Also inspect lining for cracks, flaking, burning and looseness.

b. Install rear band assembly in transmission case so that band lugs index with anchor pins.

c. Inspect support to case spacer for burrs or raised edges. If present, remove with a stone or fine sandpaper.

d. Install the support case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin, Fig. 7-198.

CAUTION: Do not confuse this spacer (.040" thick and both sides flat) with either the center support to case snap ring (one side beveled) or the intermediate clutch backing plate to case snap ring (.093" thick and both sides flat).

e. Install previously selected rear unit selective washer into slots provided inside rear of transmission case. Retain washer with petrolatum.

(NOTE: Proper washer size was determined at time of rear unit end play check.)

f. Laying gear unit on its side, install thrust washer on output flange with bent tabs in tab pockets. Retain thrust washer with petrolatum.

CAUTION: Be careful not to drop or bump gear unit assembly in transmission case during installation.

g. Install gear unit, with center support and reaction carrier, by lining up center support bolt hole with

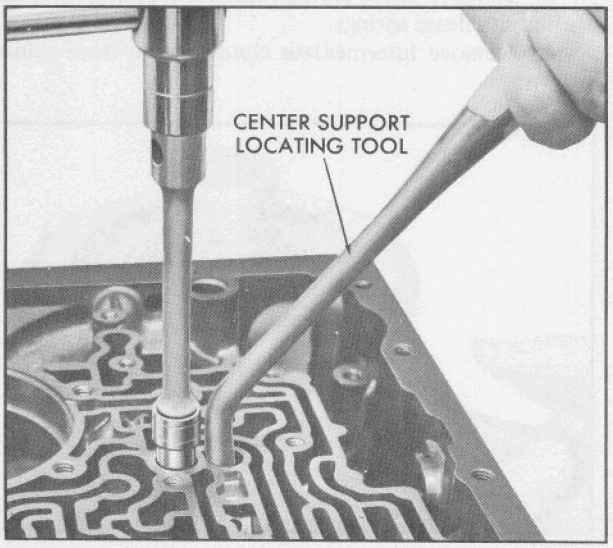


Fig. 7-199 Locating Center Support

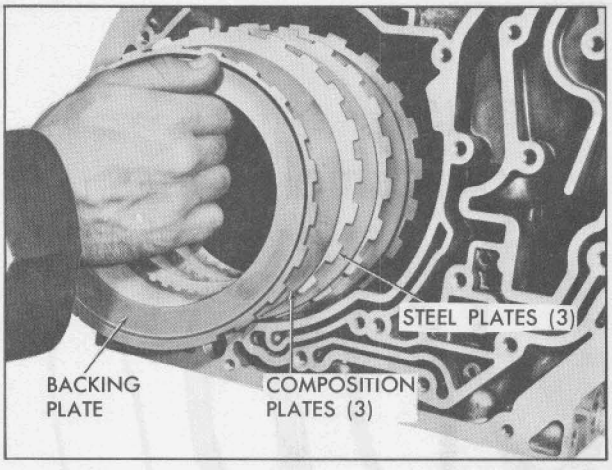


Fig. 7-200 Installing Intermediate Clutch Plates

hole in case and carefully guiding complete assembly into transmission case.

h. Lubricate center support to case snap ring with transmission fluid and install snap ring in transmission case with beveled side up, (flat side against center support) locating gap adjacent to front band anchor pin. Expand snap ring until center support is against shoulder of case.

i. Install case to center support bolt.

(NOTE: To correctly perform this operation, it will be necessary to make the tool as described in NOTE 17b, Step 11, first three paragraphs. Then follow procedure outlined below:)

Place center support locating tool into the case direct clutch passage, with the handle of the tool pointing to the left, as viewed from the front of transmission and parallel to the bell housing mounting, Fig. 7-199.

Lift upward on the tool which will tend to rotate the center support counterclockwise as viewed from the front of transmission. While holding the center support firmly counterclockwise against case splines, torque case to center support bolt to 23 ft. lbs., using a 3/8" 12-point thin-wall deep socket.

CAUTION: When using the locating tool, care should be taken not to raise burrs on the case valve mounting face.

j. Before installing intermediate clutch plates, inspect plates for signs of burning, scoring, and wear.

k. Lubricate three steel and three composition intermediate clutch plates with transmission fluid and install clutch plates in transmission case, Fig. 7-200. Start with steel plate and alternate composition and steel plates.

l. Install intermediate clutch backing plate with flat machine surface against clutch plates.

m. Install backing plate to case snap ring with snap ring gap on side of case opposite front band anchor pin.

(NOTE: Both sides of this snap ring are flat, and it is approximately .093" thick.)

1. Recheck rear unit end play as described in Note 29r.

30c. Direct Clutch and Intermediate Sprag Assembly (Fig. 7-201)

1. Disassembly

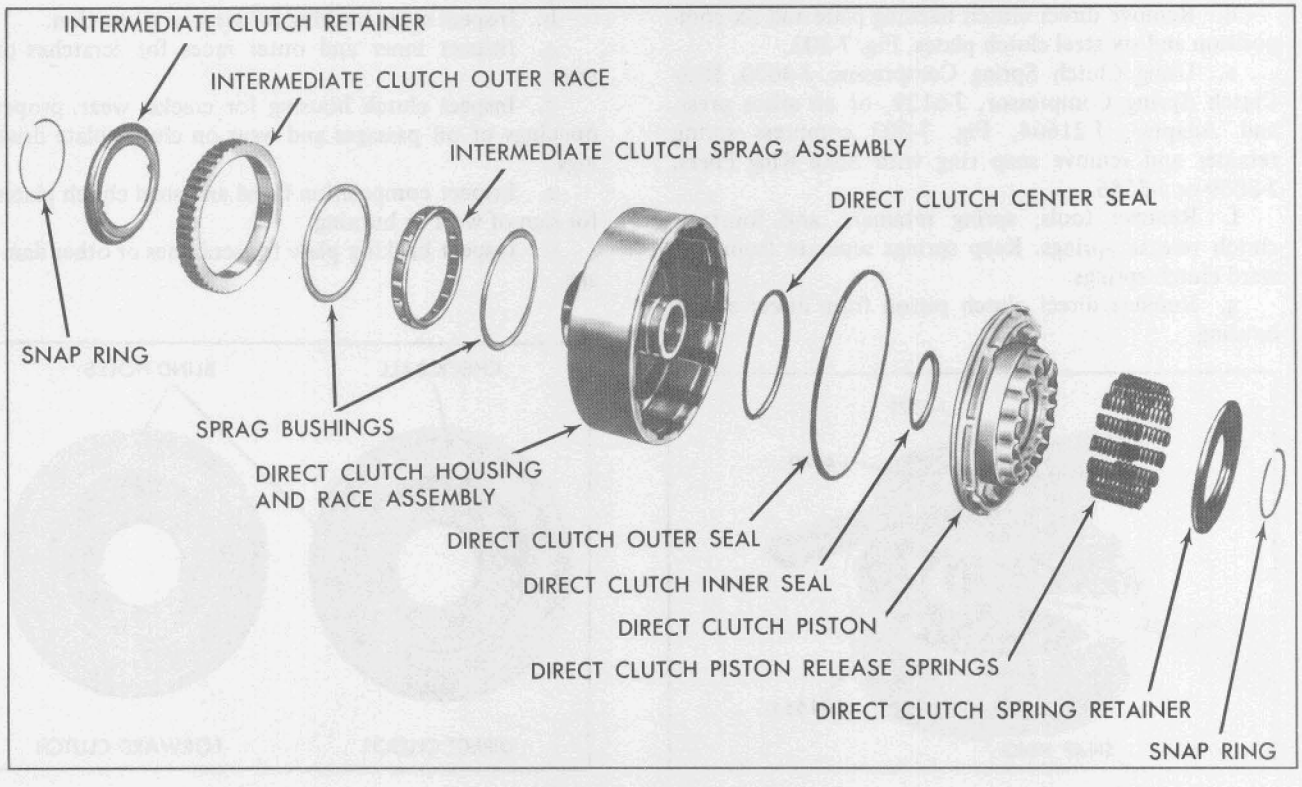


Fig. 7-201 Direct Clutch and Piston - Exploded View

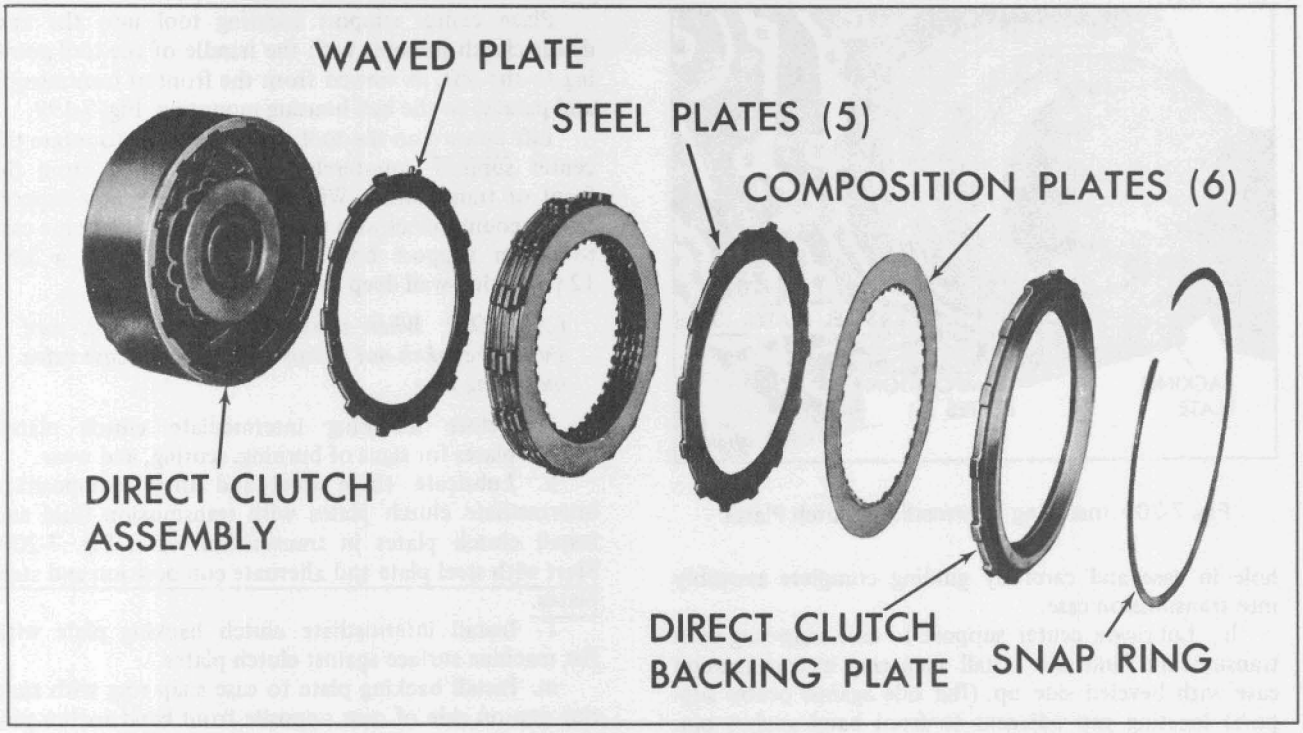


Fig. 7-202 Direct Clutch - Exploded View

a. Remove sprag retainer snap ring, and remove clutch retainer.

b. Remove sprag outer race and bushings, and remove sprag assembly from outer race.

c. Turn unit over and remove direct clutch backing plate to clutch housing snap ring.

d. Remove direct clutch backing plate and six composition and six steel clutch plates, Fig. 7-202.

e. Using Clutch Spring Compressor, J-4670, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, Fig. 7-203 compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586.

f. Remove tools, spring retainers, and fourteen clutch release springs. Keep springs separate from forward clutch springs.

g. Remove direct clutch piston from direct clutch housing.

h. Remove inner and outer seals from clutch piston.

i. Remove center piston seal from direct clutch housing.

2. Inspection

a. Inspect sprag assembly for popped or loose sprags.

b. Inspect sprag bushing for wear or distortion.

c. Inspect inner and outer races for scratches or wear.

d. Inspect clutch housing for cracks, wear, proper openings of oil passages and wear on clutch plate drive lugs.

e. Inspect composition faced and steel clutch plates for sign of wear or burning.

f. Inspect backing plate for scratches or other damage.

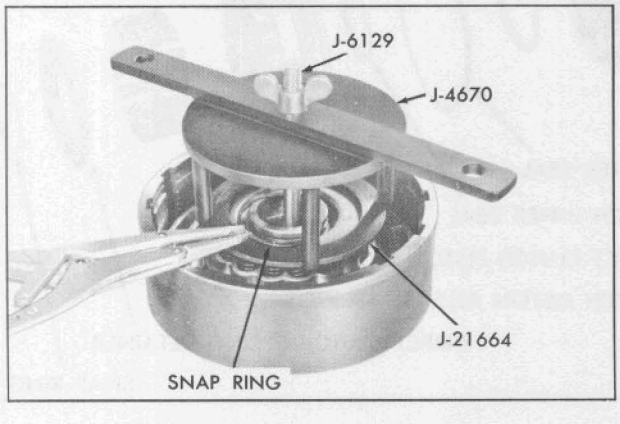


Fig. 7-203 Removing Direct Clutch Snap Ring

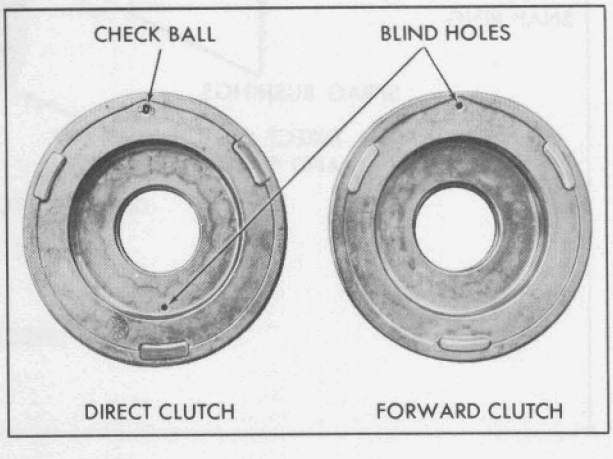


Fig. 7-204 Direct Clutch Identification

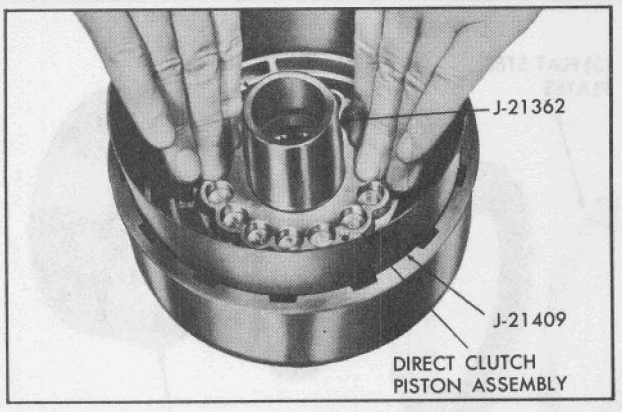


Fig. 7-205 Installing Direct Clutch Piston

g. Inspect piston for cracks and free operation of ball check.

h. Inspect springs for collapsed coils or signs of distortion.

(NOTE: The 14 direct clutch release springs are not serviced individually. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.)

3. Assembly

a. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in direct clutch piston and install seals with lips facing away from spring pockets.

(NOTE: Make certain piston has ball check, Fig. 7-204.)

b. Lubricate new center seal with transmission fluid. Lubricate seal groove in direct clutch housing and install seal in clutch housing with lip facing up.

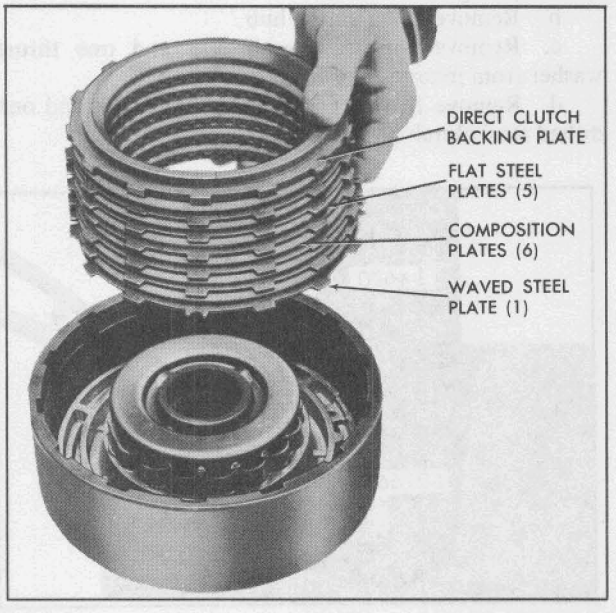


Fig. 7-206 Installing Direct Clutch Plates

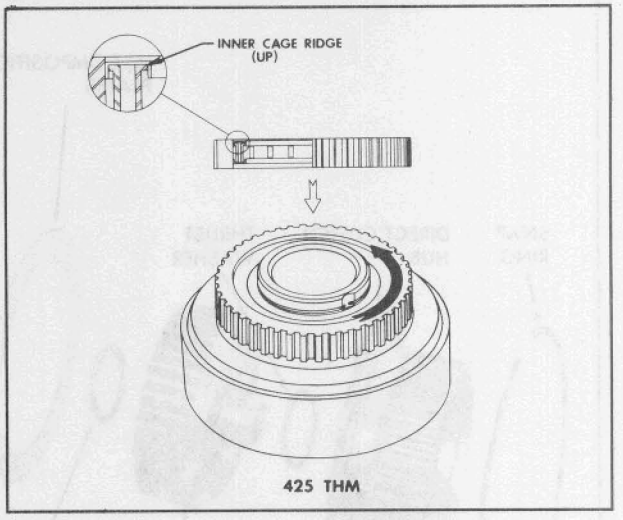


Fig. 7-207 Sprag Rotation

c. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over direct clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in direct clutch housing Fig. 7-205 and install clutch piston by rotating it slightly, in a clockwise direction.

d. Install 16 clutch release springs into spring pockets in clutch piston.

e. Place spring retainer and snap ring over springs.

f. Using Clutch Spring Compressor, J-4670, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, Fig. 7-203, compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586. Remove tools.

(NOTE: Make certain clutch release springs are not leaning. If necessary, straighten springs with a small screwdriver.)

g. Lubricate the five flat and one waved (plate with "U" notch) steel and six composition clutch plates with

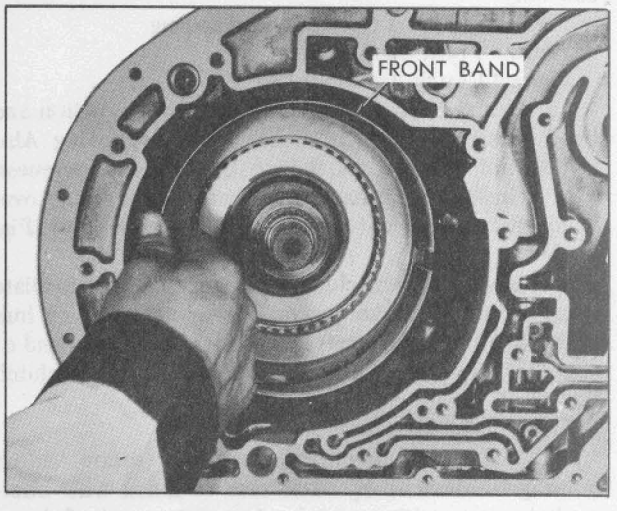


Fig. 7-208 Installing Front Band

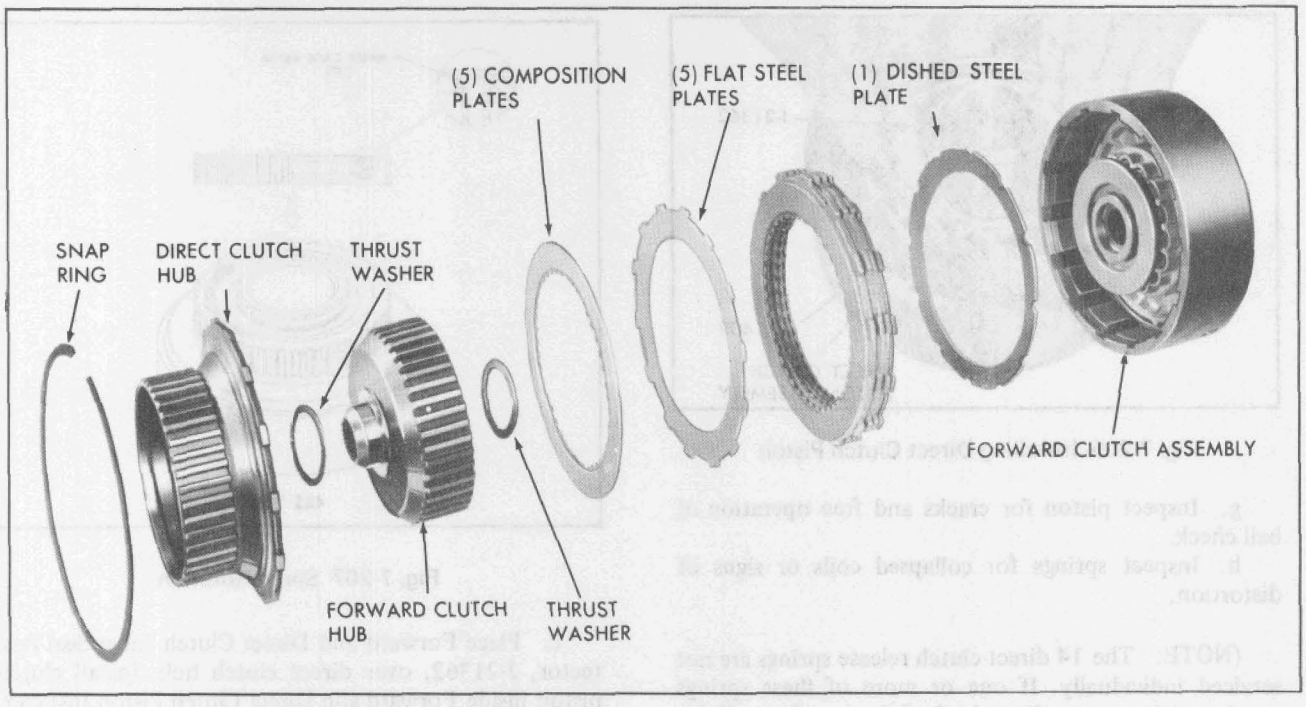


Fig. 7-209 Forward and Direct Clutches - Exploded View

transmission fluid and install clutch plates in direct clutch housing. Start with waved steel plate and alternate composition and flat steel clutch plates, Fig. 7-206.

h. Install direct clutch backing plate over clutch plates and install backing plate snap ring.

i. Invert clutch housing and install one sprag bushing, cup side up, around sprag inner race.

j. Install sprag assembly into clutch outer race.

k. With ridge on inner cage of sprag facing up install sprag and outer race on inner race with counterclockwise turning motion.

(NOTE: When installed, outer race should turn only counterclockwise, Fig. 7-207.)

1. Install sprag bushing, cup side down, over sprag assembly.

m. Install sprag retainer and snap ring.

4. Install Front Band and Direct Clutch Assembly

a. Inspect front band for cracks or distortion and band ends for damage at anchor lug and apply lug. Also inspect lining for cracks, flaking, burning, and looseness.

b. Install front band with band anchor hole over band anchor pin, and apply lug facing servo hole, Fig. 7-208.

c. Install direct clutch housing and intermediate sprag assembly. Make certain that clutch housing hub bottoms on sun gear shaft and splines on forward end of sun gear shaft are flush with splines in direct clutch housing.

(NOTE: It will be necessary to rotate clutch housing to allow sprag outer race to index with intermediate composition clutch plates. Removal of direct clutch composition-faced and steel plates may be helpful, and applying air pressure through the center support screw to apply the intermediate clutch plates may facilitate assembly.)

d. Check operation of direct clutch by applying air pressure through direct clutch passage next to center support bolt, Fig. 7-88.

30d. Forward Clutch Assembly

1. Disassembly (Fig. 7-209)

a. Remove forward clutch housing to direct clutch hub snap ring.

b. Remove direct clutch hub.

c. Remove forward clutch hub and one thrust washer from inner side of hub.

d. Remove five composition and five flat and one dished steel clutch plates.

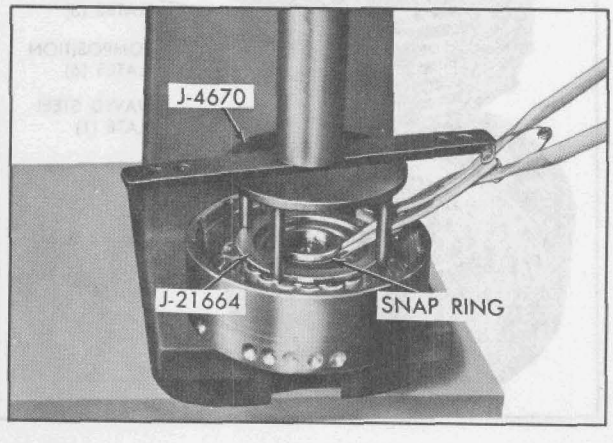


Fig. 7-210 Installing Forward Clutch Snap Ring

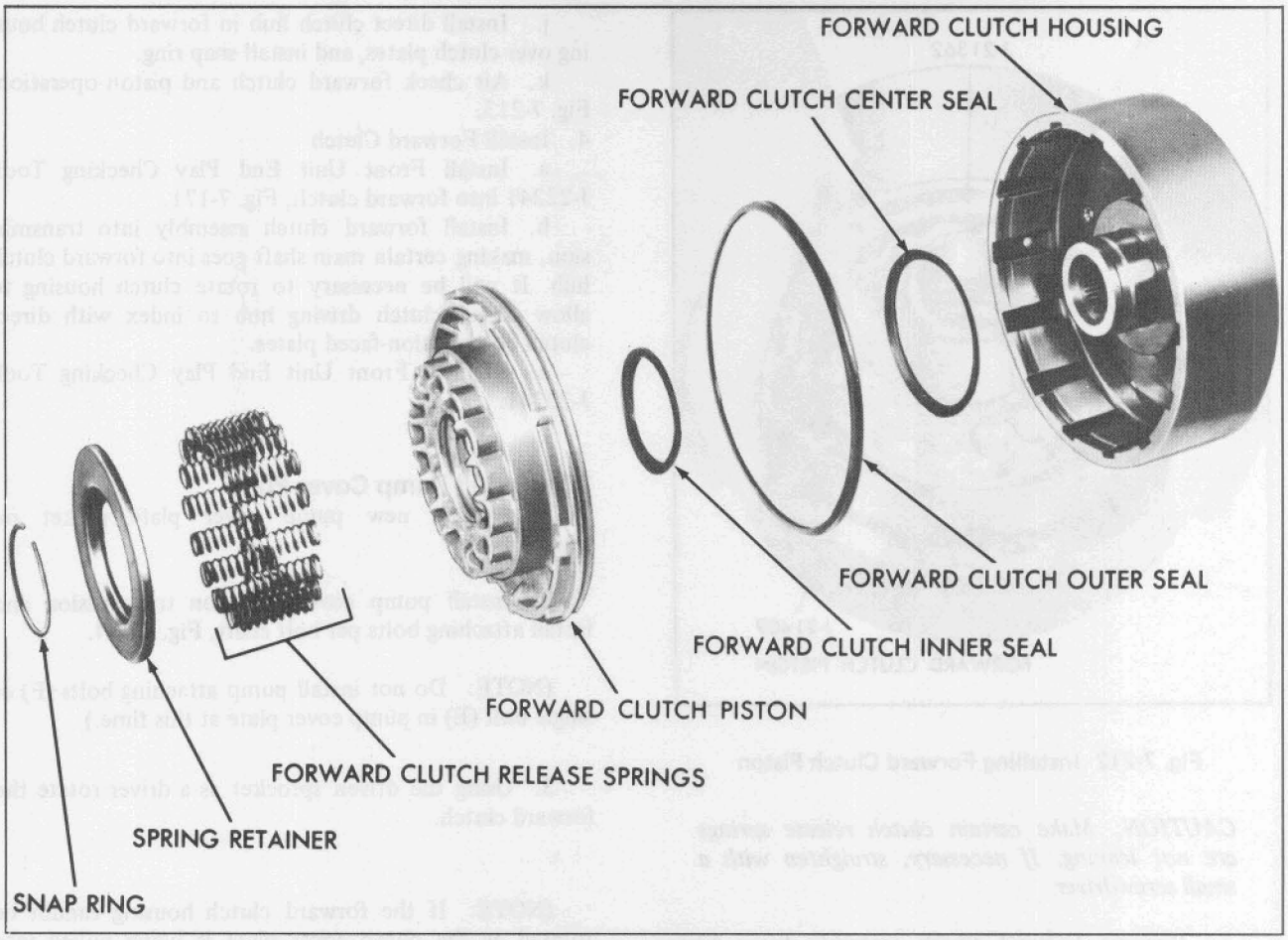


Fig. 7-211 Forward Clutch - Exploded View

e. Using Clutch Spring Compressor, J-4670, and Adapter, J-21664, compress spring retainer with arbor press and remove snap ring using Snap Ring Pliers, J-8059 or J-5586, Fig. 7-210.

f. Remove tools, spring retainer and 16 clutch release springs. Keep springs separate from direct clutch springs.

g. Remove forward clutch piston from forward clutch housing.

h. Remove inner and outer seals from clutch piston.

i. Remove center piston seal from forward clutch housing.

2. Inspection

a. Inspect composition-faced and steel clutch plates for signs of burning, scoring or wear.

b. Inspect sixteen release springs for collapsed coils or signs of distortion.

c. Inspect clutch hubs for worn splines, proper lubrication holes, and thrust faces.

d. Inspect piston or cracks.

e. Inspect clutch housing for wear, scoring, cracks and open oil passages.

3. Assembly (Fig. 7-211)

a. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in forward clutch piston with petrolatum and install seals with lips facing away from spring pockets.

(NOTE: The forward and direct clutch pistons have identical inside and outside diameters. Therefore, extreme care should be exercised during reassembly to assure the proper piston be installed in the clutch assemblies. The forward clutch piston can be identified by the absence of a check ball in the clutch apply face of the piston, Fig. 7-204.)

b. Lubricate new center piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and install seal into clutch housing with lip facing up.

c. Place forward and Direct Clutch Inner Seal Protector, J-21362, over forward clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in forward clutch housing, Fig. 7-211 and install clutch piston by rotating it slightly in a clockwise direction until seated, Fig. 7-212.

d. Install sixteen clutch release springs into spring pockets in clutch piston.

e. Using Clutch Spring Compressor, J-4670, and Adapter, J-21664, compress spring retainer with arbor press, being careful that retainer does not catch in snap ring groove, and install snap ring using Snap Ring Pliers, J-8059 or J-5586, Fig. 7-210 and remove tools.

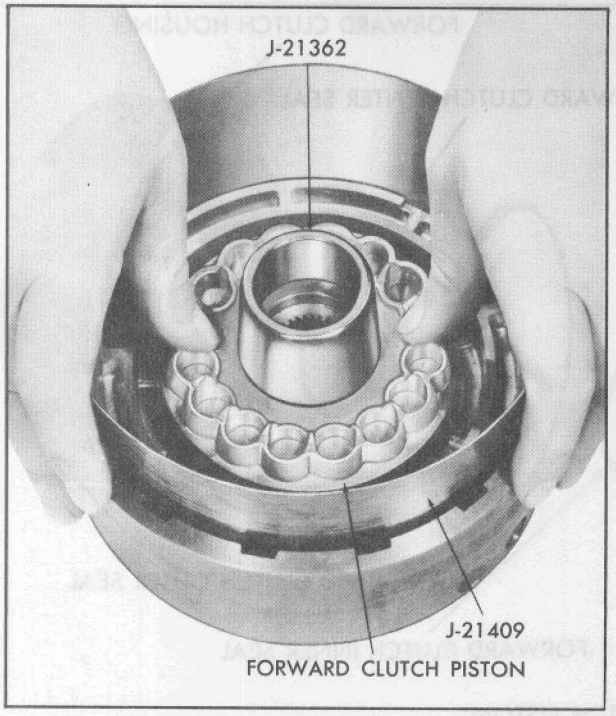


Fig. 7-212 Installing Forward Clutch Piston

CAUTION: Make certain clutch release springs are not leaning. If necessary, straighten with a small screwdriver.

f. Remove forward clutch assembly from arbor press and place on work bench.

g. Install the forward clutch hub thrust washers on the forward clutch hub. Retain with petrolatum.

h. Install forward clutch hub in forward clutch housing.

i. Lubricate the dished and five flat steel and five composition clutch plates with transmission fluid and install clutch plates in forward clutch housing. Start with dished steel plate (O.D. up) and place a flat steel plate on top of the dished steel plate. Then alternate composition and flat steel clutch plates.

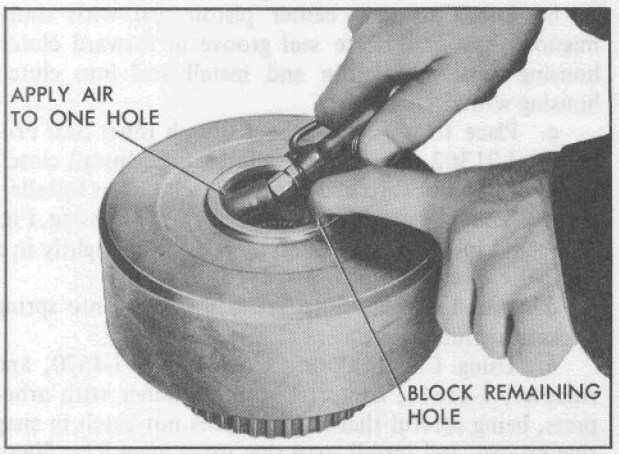


Fig. 7-213 Air Checking Forward Clutch

j. Install direct clutch hub in forward clutch housing over clutch plates, and install snap ring.

k. Air check forward clutch and piston operation, Fig. 7-213.

4. Install Forward Clutch

a. Install Front Unit End Play Checking Tool, J-22241 into forward clutch, Fig. 7-171.

b. Install forward clutch assembly into transmission, making certain main shaft goes into forward clutch hub. It will be necessary to rotate clutch housing to allow direct clutch driving hub to index with direct clutch composition-faced plates.

c. Remove Front Unit End Play Checking Tool, J-22241.

30e. Install Pump Cover Plate

1. Install new pump cover plate gasket on transmission.

2. Install pump cover plate on transmission and install attaching bolts per bolt chart, Fig. 7-214.

(NOTE: Do not install pump attaching bolts (F) or single bolt (E) in pump cover plate at this time.)

3. Using the driven sprocket as a driver rotate the forward clutch.

(NOTE: If the forward clutch housing cannot be rotated as the pump cover plate is being pulled into place, the forward or direct clutch housings have not been properly installed to index with all the clutch plates. This condition must be corrected before the pump cover plate is pulled fully into place.)

4. Torque all bolts to 20 foot-pounds.

5. Repeat front unit end play check as described in Note 29n.

6. Install remaining bolt (E) in driven support housing, tightening to 20 foot-pounds.

30f. Oil Pump

1. Disassembly

a. Mark drive and driven gears for reassembly in same position and remove the pump body.

(NOTE: Installing the gears in the same position as removed will assure the quietest operation, as the gear teeth will mesh in the established wear pattern.)

b. Remove drive and driven gears from pump body.

c. Remove and discard pump body to case square-cut O-ring seal.

2. Inspection

a. Using tip of finger, inspect gear pocket and crescent for nicks, burrs, scoring or galling.

b. Inspect drive gear for nicks, burrs, scoring, or galling.

c. Inspect driven gear for nicks, burrs, scoring, or galling.

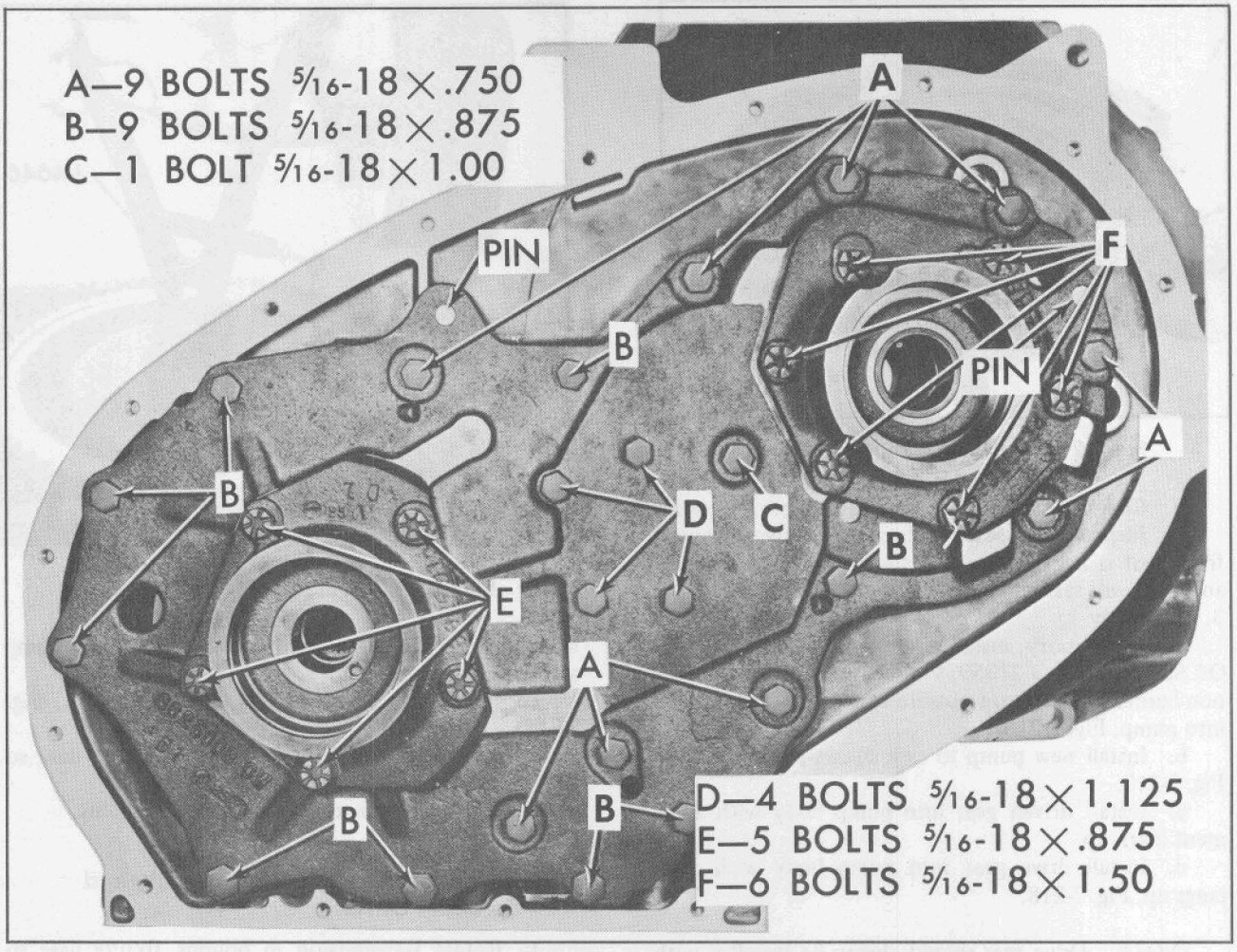


Fig. 7-214 Pump Cover Plate Bolts

d. Place pump gears in pump body and check pump body face to gear face clearance. Clearance should be .0013" - .0035".

e. Check face of pump body for nicks, burrs, scoring, or galling.

f. Check pump body face flatness. Overall flatness should be .000" to .002".

g. Inspect bushing for nicks, burrs, scoring, galling, out-of-round, or excessive wear.

(NOTE: To check for out-of-round, install pump body on the converter hub and look for eccentricity between pump bushing and converter hub.)

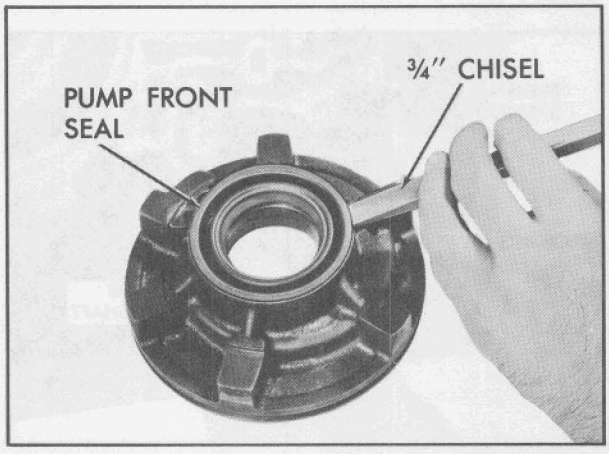


Fig. 7-215 Removing Pump Front Seal

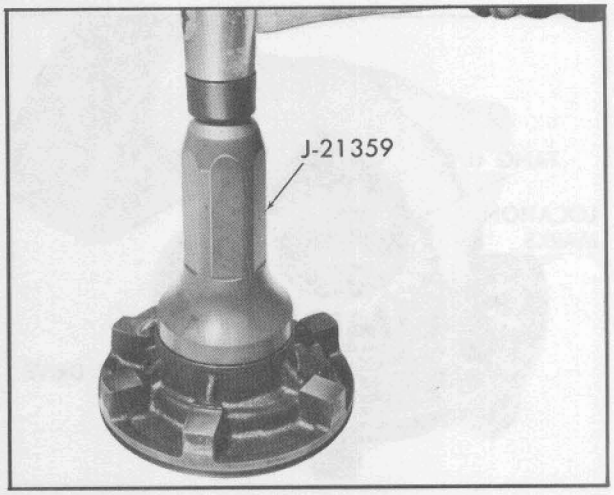


Fig. 7-216 Installing Pump Front Seal

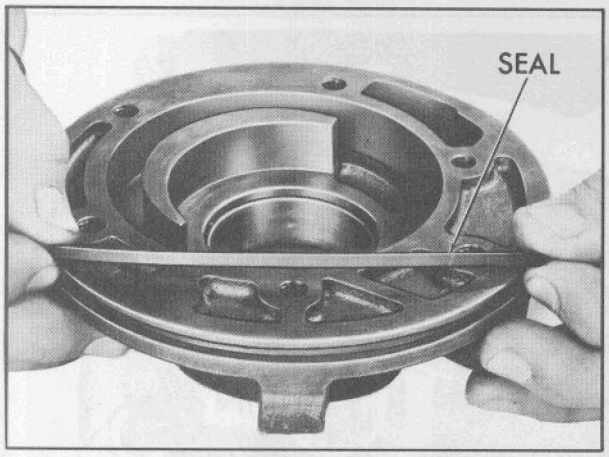


Fig. 7-217 Installing Pump to Case Seal

h. Check for damaged pump cover plate bolt holes.

i. Inspect front seal for damage. If replacement of front seal is necessary, use a standard 3/4" cold chisel and pry front seal pump body, Fig. 7-215.

3. Assembly

a. If necessary, install a new front seal, using Pump Oil Seal Installer, J-21359, to drive seal into place. Use a non-hardening sealer on outside of seal before installing into pump, Fig. 7-216.

b. Install new pump to case square-cut O-ring seal, Fig. 7-217.

c. Install driven gear into pump body with alignment mark up.

d. Install drive gear into pump body with drive tangs up, Fig. 7-218.

(NOTE: Drive gear should always be installed with counterbore down.)

4. Install

a. Rotate transmission in holding fixture base so that cored oil passages are up.

b. Install pump assembly over stator shaft and position to drive support housing, rotating pump as necessary to align holes in pump cover plate with pump attaching bolt holes.

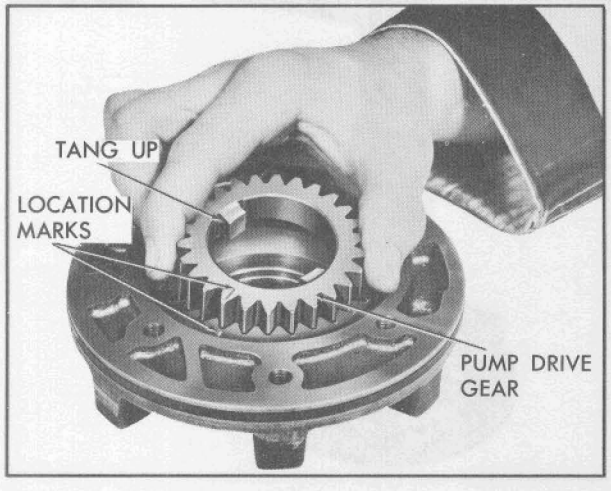


Fig. 7-218 Installing Pump Drive Gear

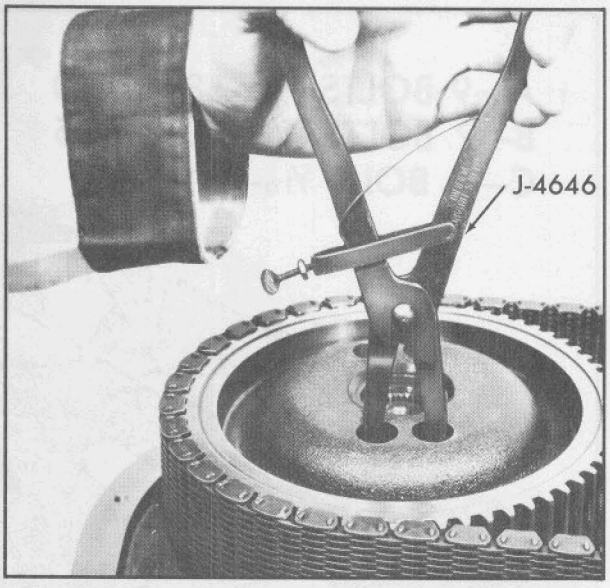


Fig. 7-219 Installing Sprocket Snap Ring

c. Install six retaining bolts (F), finger tight, Fig. 7-214.

d. Rotate transmission in holding fixture base so that pump cover plate is up.

e. Tighten pump attaching bolts to 20 ft. lbs.

30g. Install Sprockets, Link Assembly and Sprocket Cover

1. Rotate transmission in holding fixture base so that cored oil passages are up.

2. Position drive and driven sprockets on workbench with shafts up, and drive sprocket closest to transmission.

3. Install link assembly over drive and driven sprockets with colored guide link, which has etched numerals, down.

4. Lift sprockets and link assembly and rotate assemblies 90° so that drive sprocket is up.

5. Allowing driven sprocket to hang down freely,

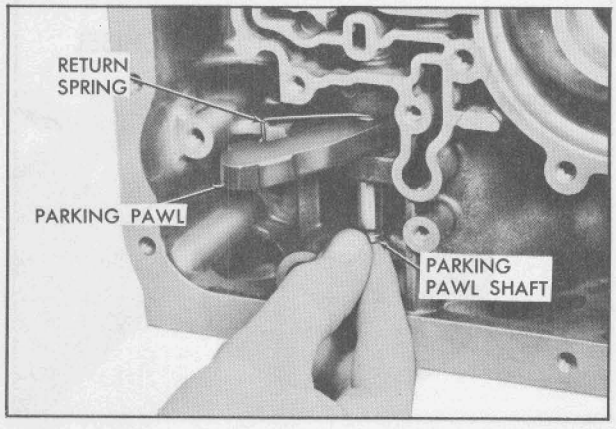


Fig. 7-220 Installing Parking Pawl

start turbine shaft into pump support housing until it will support weight of assembly.

6. Start input shaft into driven support housing, and alternately push shafts inward until sprockets are installed.

7. Rotate transmission in holding fixture base so that sprockets are up.

8. Using a plastic mallet, gently tap sprockets to seat sprocket bearing assemblies into support housing.

9. Install Snap Ring Pliers, J-4646, into sprocket bearing retainer snap rings, located under the drive and driven sprockets, and install snap rings into retaining grooves on support housings, Fig. 7-219.

10. Install new sprocket cover to case gasket on transmission case.

11. Position sprocket cover to transmission case and install 18 attaching bolts, tightening bolts to 8 ft. lbs.

(NOTE: One sprocket cover attaching bolt is 1/4 inch longer. This bolt must be installed in the tapped hole directly over the cooler fittings on the transmission case.)

30h. Detent Lever, Manual Shaft, Parking Linkage, Rear Servo, Front Servo, Check Balls, and Control Valve Spacer

1. Inspect Detent Lever, Manual Shaft, and Parking Linkage

a. Inspect parking actuator rod for cracks, or broken spring retainer lugs.

b. Inspect actuator spring for damage.

c. Inspect actuator for a free fit on actuator rod.

d. Inspect parking pawl for cracks or wear.

e. Inspect manual shaft for damaged threads.

f. Inspect inside detent lever for cracks or a loose pin.

g. Inspect parking pawl return spring for deformed coils or ends.

h. Inspect parking bracket for cracks or wear.

i. Inspect detent spring and roller assembly.

2. Install Detent Lever, Manual Shaft and Parking Linkage

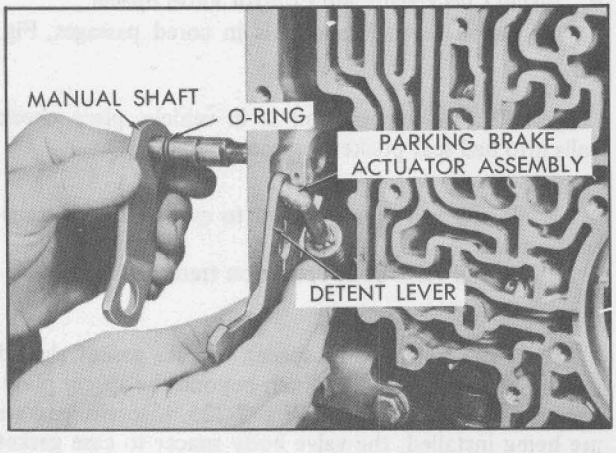


Fig. 7-221 Installing Manual Shaft

a. Install parking pawl (tooth toward inside of case), pawl return spring and parking pawl shaft into case, Fig. 7-220.

b. Install parking pawl shaft retaining pin into case hole.

c. Install parking bracket into case, tightening attaching screws to 18 ft. lbs.

d. Install a new manual shaft O-ring seal on manual shaft.

e. Install the actuator rod plunger under the parking bracket and over the parking pawl and through hole in detent lever. Position detent lever in transmission case.

f. Install the manual shaft assembly through the retaining lock nut on manual shaft, Fig. 7-221.

g. Install manual shaft retaining pin into case, long smooth end first.

h. Torque lock nut to 18 ft. lbs.

3. Disassemble Rear Servo Assembly (Fig. 7-222)

a. Remove rear accumulator piston from rear servo piston.

b. Remove E-ring retaining rear servo piston to band apply pin.

c. Remove rear servo piston and seal from band apply pin.

d. Remove washer, spring and retainer.

4. Inspect Rear Servo

a. Check freeness of oil seal rings in accumulator piston grooves.

(NOTE: See Fig. 7-222. Do not remove the teflon oil seal rings from the rear accumulator piston, unless the oil seal rings require replacement.

If the teflon inner oil seal ring, (small diameter) requires replacement, for service, use the aluminum oil seal ring.

The rear accumulator piston, large diameter ring groove depth, is machined shallower to take the large teflon oil seal ring; if this requires replacement, use only the teflon oil seal ring.)

b. Inspect fit of band apply pin in servo piston.

c. Inspect band apply pin for scores or cracks.

d. Inspect band apply pin for proper size as determined by pin selection check (Note 29h).

5. Assemble Rear Servo

a. Install spring retainer, cup side first, servo pin spring and washer on servo pin.

b. Install servo piston on pin and secure with E-ring retainer.

c. If removed, install oil seal ring on servo piston.

d. If removed, install inner and outer oil rings on accumulator piston.

e. Install accumulator piston into bore of servo piston.

6. Install Rear Servo

(NOTE: If the transmission is in the vehicle, a sheet metal bracket will be required to hold the rear servo assembly, front servo assembly, check balls, valve body to spacer plate gasket and valve body spacer plate, until the control valve assembly is installed. See Fig. 7-229.)

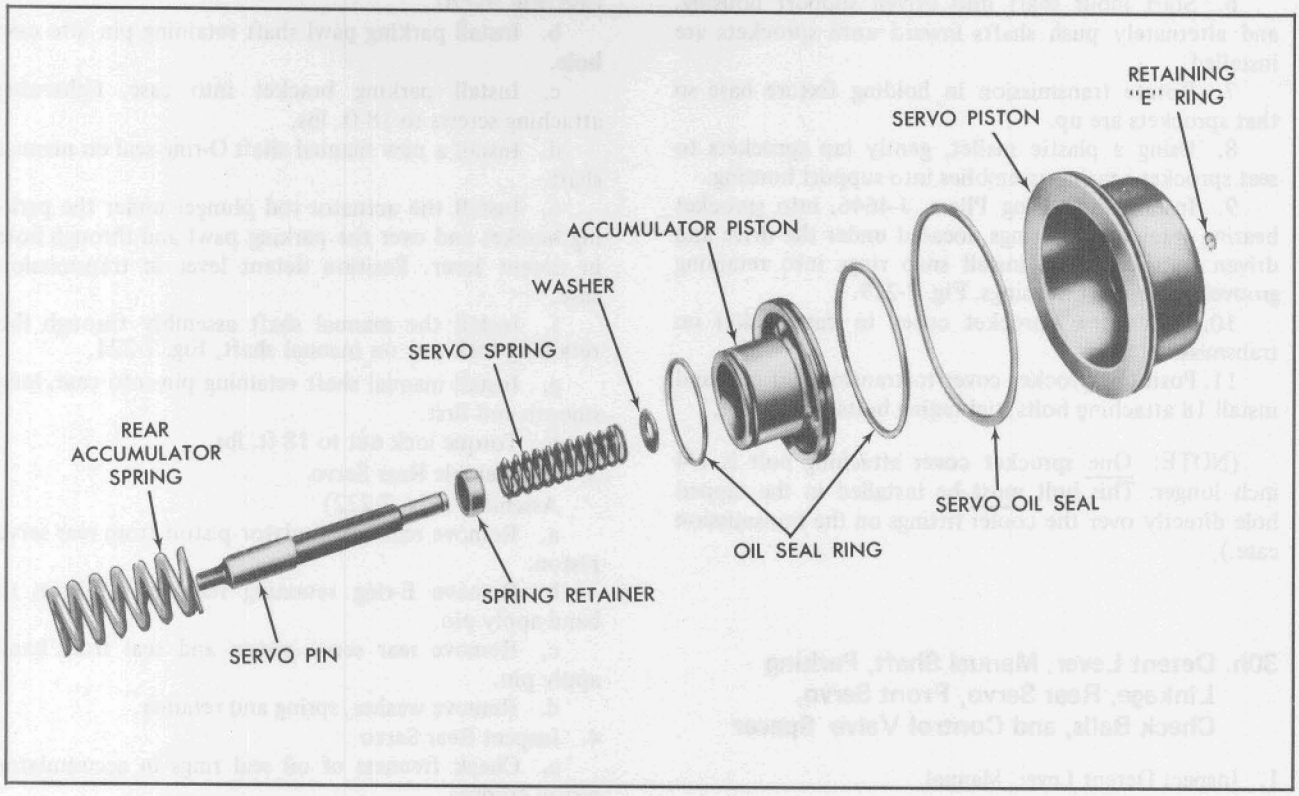


Fig. 7-222 Rear Servo and Accumulator - Exploded View

a. Lubricate inner and outer rear servo bores in transmission case with transmission fluid and install rear accumulator spring in servo inner bore.

(NOTE: Before installing rear servo assembly, make certain that rear band apply lug is aligned with servo pin bore in transmission case. Otherwise servo pin will not apply band.)

b. Position rear servo assembly in transmission case bore.

c. Press down on rear servo assembly, making certain oil seal ring is properly seated in case bore.

7. Inspect Front Servo

(NOTE: See Fig. 7-222. Do not remove the teflon oil seal ring from the front accumulator piston unless the oil seal ring requires replacement. For service, the oil seal ring will be cast iron.)

CAUTION: The front accumulator piston for 1971 and 1972 is not interchangeable with the pre-1971 piston.

a. Inspect servo pin for damage.
b. Inspect piston oil ring for damage.
c. Inspect piston for cracks or porosity.
d. Check fit of servo pin in piston and case.

8. Install Front Servo Assembly

a. Reassemble parts of front servo, Fig. 7-223, making sure tapered end of servo pin is pointed through the spring and spring retainer, and install in bore in case. Make sure the retainer ring is installed in the servo pin groove.

(NOTE: The teflon ring allows the front servo piston to slide very freely in the case. The free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.)

9. Install Check Balls and Control Valve Spacer

a. Install seven check balls in cored passages, Fig. 7-224.

(NOTE: If transmission is in vehicle, place check balls into ball seat pockets on spacer plate.)

b. Install valve body spacer to case gasket on transmission case.

c. Install valve body spacer on transmission.

(NOTE: Valve body spacer to case gasket should extend approximately 1/8 inch beyond the spacer plate, over the void case channel, Fig. 7-225. If service gaskets are being installed, the valve body spacer to case gasket has an extension which will cover the void case channel.)

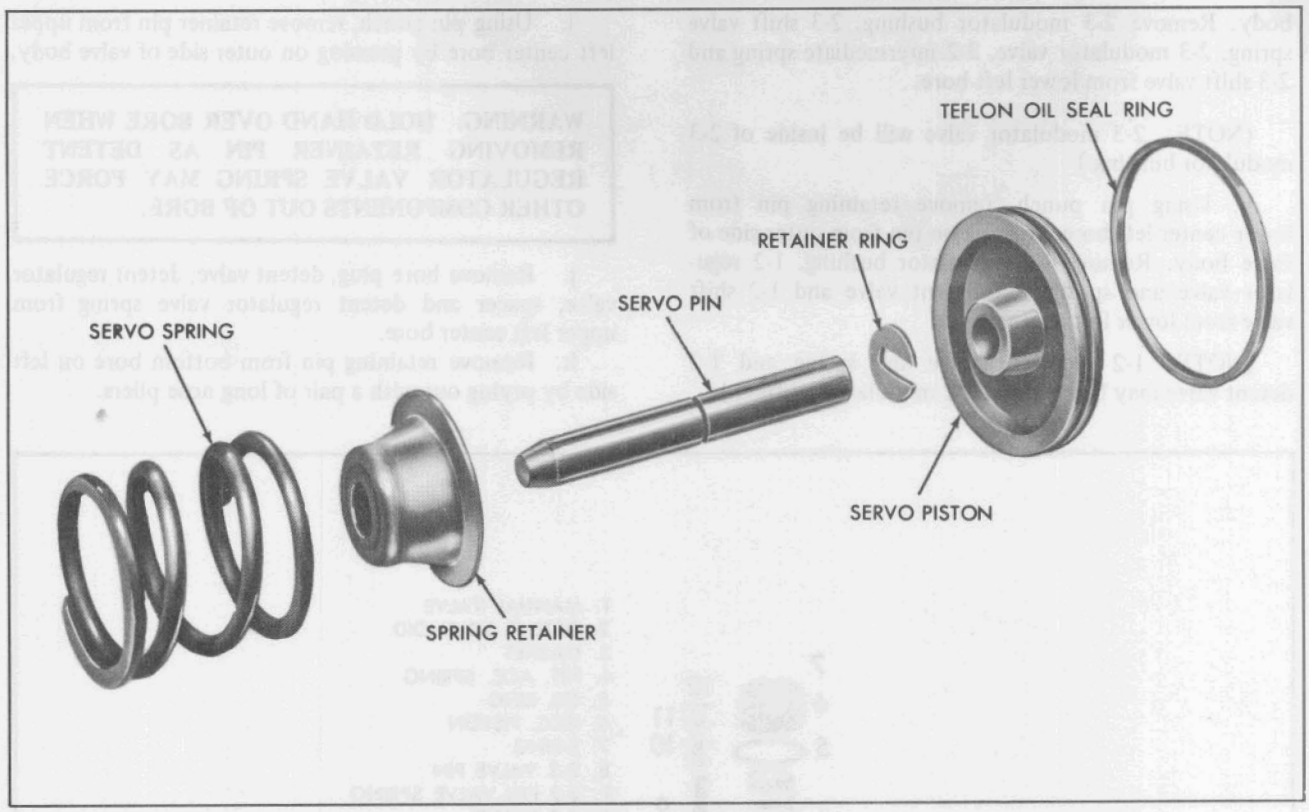


Fig. 7-223 Front Servo - Exploded View

d. Install valve body to spacer gasket.
e. Install guide pins.

30i. Control Valve Assembly (Fig. 7-226)

1. Disassembly

When disassembling control valve, make certain that springs are accurately identified so that they can be properly reassembled.

a. Position control valve assembly with cored face down.

b. Remove two screws securing detent solenoid to control valve body and remove detent solenoid and gasket.

c. Position control valve assembly with cored face up and accumulator pocket on bottom.

d. Remove manual valve from upper bore.

e. Install Control Valve Accumulator Piston Installer, J-21885, on accumulator piston, compress piston and remove E-ring retainer, Fig. 7-227.

f. Remove Installer, J-21885, and remove accumulator piston and spring.

g. Using pin punch, remove retaining pin from lower left bore, pressing on pin from outer side of valve

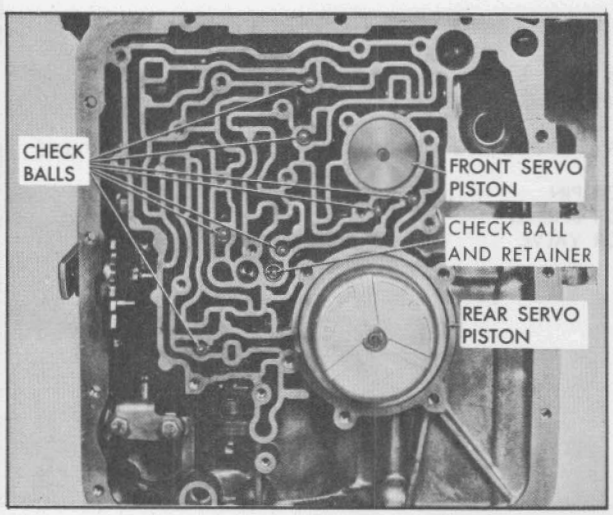


Fig. 7-224 Location of Check Balls

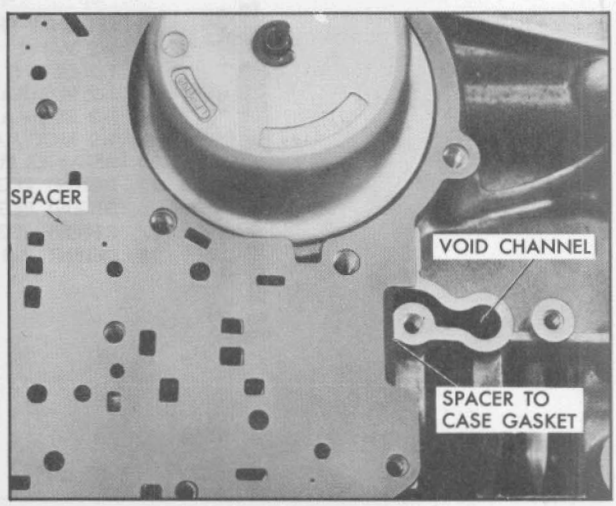


Fig. 7-225 Valve Body Spacer to Case Gasket

body. Remove 2-3 modulator bushing, 2-3 shift valve spring, 2-3 modulator valve, 3-2 intermediate spring and 2-3 shift valve from lower left bore.

(NOTE: 2-3 modulator valve will be inside of 2-3 modulator bushing.)

h. Using pin punch, remove retaining pin from lower center left bore, pressing on pin from outer side of valve body. Remove 1-2 modulator bushing, 1-2 regulator valve and spring, 1-2 detent valve and 1-2 shift valve from lower left center bore.

(NOTE: 1-2 regulator valve and spring and 1-2 detent valve may be inside of 1-2 modulator bushing.)

i. Using pin punch, remove retainer pin from upper left center bore by pressing on outer side of valve body.

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS DETENT REGULATOR VALVE SPRING MAY FORCE OTHER COMPONENTS OUT OF BORE.

j. Remove bore plug, detent valve, detent regulator valve, spacer and detent regulator valve spring from upper left center bore.

k. Remove retaining pin from bottom bore on left side by prying out with a pair of long nose pliers.

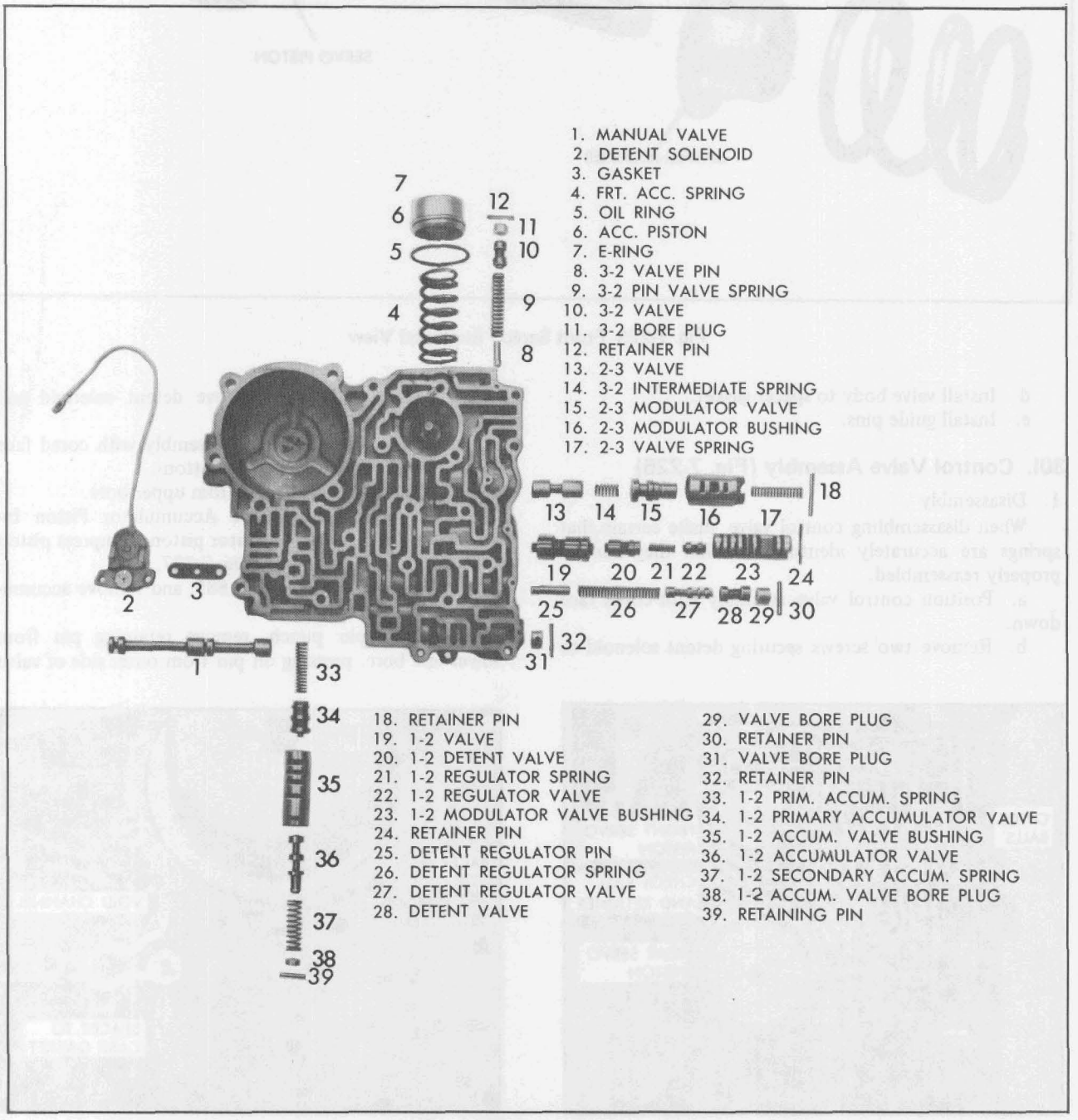


Fig. 7-226 Control Valve - Exploded View

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS 3-2 VALVE SPRING MAY FORCE BORE PLUG OUT.

l. Remove bore plug, 3-2 valve, spring and spacer from bottom left bore.

m. Remove retaining pin from top bore by prying out with long nose pliers from outer side of valve body.

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS ACCUMULATOR SPRINGS MAY FORCE OTHER COMPONENTS OUT OF BORE.

n. Remove bore plug, 1-2 accumulator valve bushing, 1-2 accumulator valve and secondary spring, 1-2 accumulator primary valve and spring.

2. Inspection

(NOTE: See Fig. 7-223. Do not remove the teflon oil seal ring from the front servo piston unless the oil seal ring requires replacement. For service, the oil seal ring will be aluminum.)

CAUTION: The spring retainer, servo pin, retainer ring and servo piston are identical for 1971 and 1972. These individual parts are not interchangeable with the pre-1971 parts.

a. Wash control valve body, valves, and other parts in clean solvent.

CAUTION: Do not allow valves to bump together, as this might cause nicks and burrs.

b. Inspect all valves and bushings carefully to make sure that they are free from dirt and are not damaged in any respect. If burrs are present, they should be removed with a fine stone or fine grade of crocus cloth and light oil. Be careful not to round off shoulders of valves.

c. All valves and bushings should be tested in their individual bores to make certain that free movement can be obtained. All valves should fall freely of their own weight with a slight tapping action on the body. In checking be careful to prevent valve damage in any way.

d. The manual valve is the only valve that can be serviced separately. If other valves are defective or damaged beyond repair, a new control valve assembly should be installed.

e. Inspect body for cracks or scored bores.

f. Check all springs for distortion or collapsed coils.

g. Inspect piston and oil ring for damage.

3. Assembly (Fig. 7-226)

a. Position control valve body with cored faced up and accumulator pocket on bottom.

b. Install the 1-2 primary accumulator spring into the 1-2 primary accumulator valve and install both, spring first, into top bore, using a retainer pin to temporarily hold valves and spring in their operating position.

c. Install the 1-2 accumulator valve, wide land first, into the 1-2 accumulator bushing.

d. Install the 1-2 accumulator valve bushing into the top bore, aligning the square port on the end of the bushing with hole for retaining pin.

e. Install the 1-2 secondary accumulator spring and the 1-2 bore plug into bushing.

f. Compress 1-2 accumulator valve train, install grooved retaining pin, grooved end entering hole last from outer side of valve body, pressing pin flush with valve body. Remove the temporary retaining pin.

g. Insert spacer inside of 3-2 valve spring and install spring and spacer in bottom left bore.

h. Install 3-2 valve in bottom left bore.

i. Compressing 3-2 valve spring, install bore plug, hole end out, and secure with grooved retaining pin from cored side of valve body.

j. Insert spacer inside of detent regulator valve spring and install spring and spacer into upper left center bore, making certain spring seats in bottom of bore.

k. Compress detent regulator valve spring and hold with a small screwdriver placed between end of spring and wall on cored side of valve body.

l. Install detent regulator valve, stem end out, and detent valve, small land first, into upper left center bore.

m. Insert bore plug, hole out, into upper left center

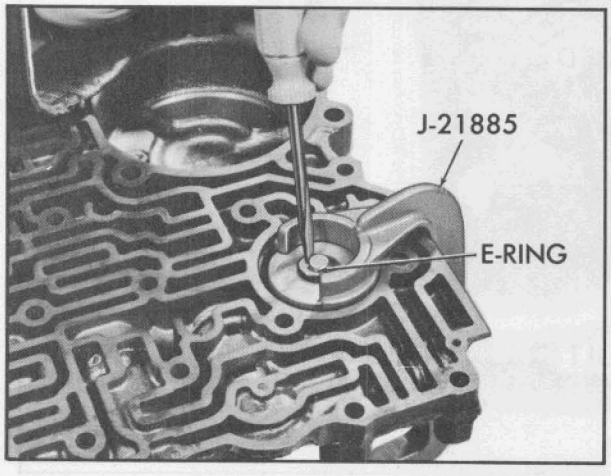


Fig. 7-227 Removing Front Accumulator

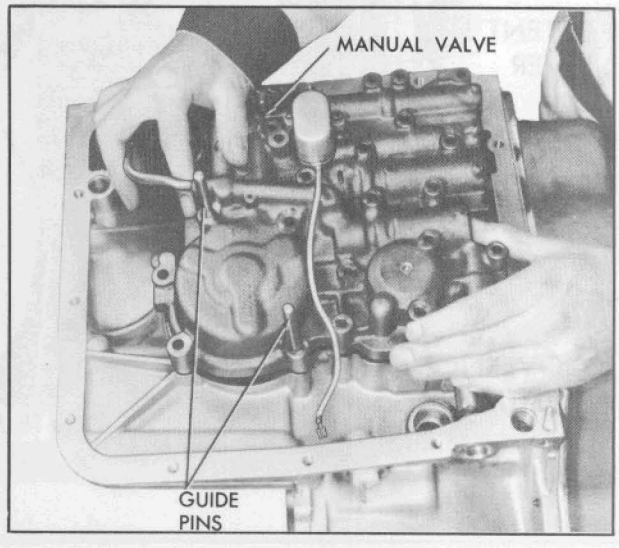


Fig. 7-228 Installing Control Valve Assembly

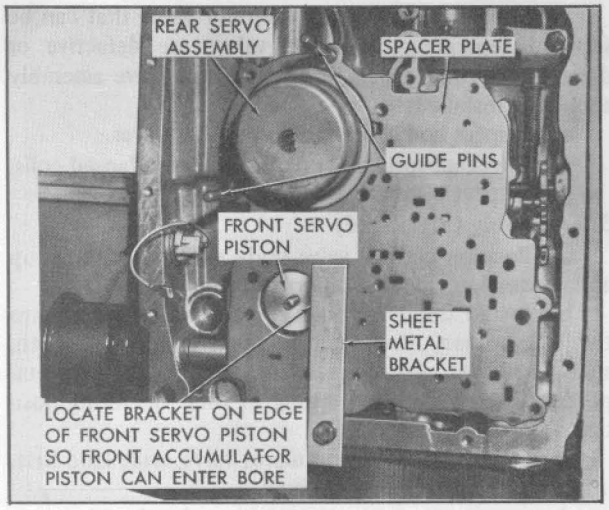


Fig. 7-229 Installing Control Valve Assembly (In Car)

bore and, pressing inward on bore plug, remove screwdriver and install remaining pin from cored side of valve body.

n. Install 1-2 shift valve, longer stem end first, in lower left center bore, making certain valve seats in bottom of bore.

o. Install 1-2 regulator valve and spring and 1-2 detent valve into 1-2 modulator bushing. Install assembly into lower left center bore of control valve body, open end of bushing first.

p. Compress bushing against spring and secure with retaining pin from cored side of control valve body.

q. Install 3-2 intermediate spring in open end of 2-3 shift valve, and install valve and spring, valve first, into lower left bore. Make certain valve seats in bottom of bore.

r. Install 2-3 modulator valve, hole end first, into 2-3 modulator bushing and install both parts in lower left bore.

s. Install 2-3 shift valve spring into hole in 2-3 modulator valve, and compressing spring, secure with retaining pin from cored side of control valve.

t. Position front accumulator spring and piston into valve body and install Control Valve Accumulator Piston Installer, J-21885, on piston. Compress spring and piston, aligning spring and piston with bore, Fig. 7-227.

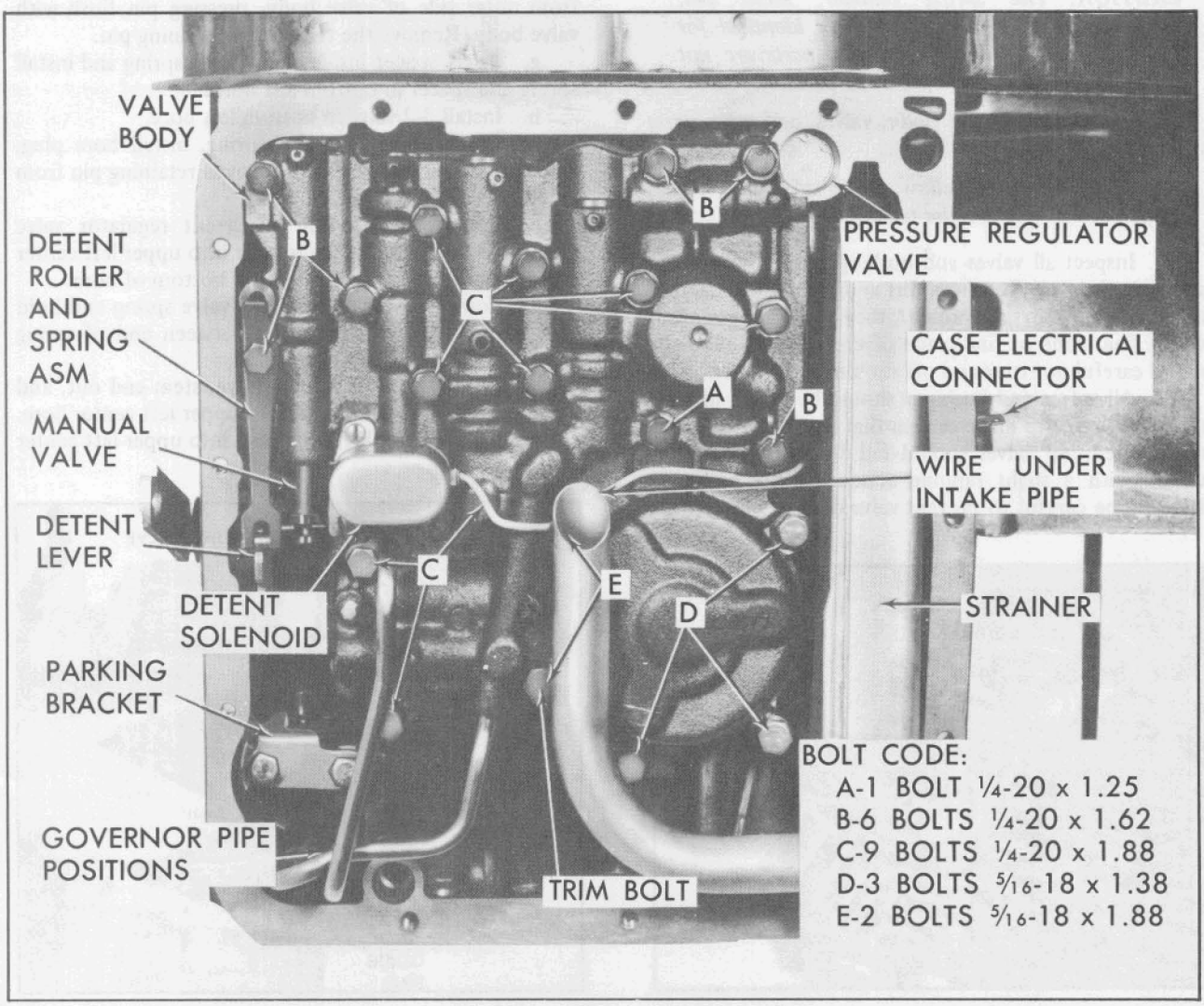


Fig. 7-230 Control Valve Bolts

CAUTION: Make certain that piston pin is correctly aligned with hole in piston and that oil seal ring does not catch on lip of bore when installing piston.

u. Secure piston and spring with E-ring retainer and remove Installer, J-21885.

v. Install manual valve into top bore.

w. Placing control valve assembly on cored surface, position detent solenoid gasket and detent solenoid on valve body.

x. Install detent solenoid attaching screws.

y. Install governor drive pipe into control valve body in bore by rear servo cover.

4. Install Control Valve Assembly

a. Using two guide pins, Fig. 7-228, install control valve assembly and governor pipe on transmission. Make certain gaskets and spacer do not become mispositioned.

(NOTE: Check manual valve to make sure it is indexed properly with pin on detent lever and governor pipe to make certain it is properly seated in case hole.)

b. Remove guide pins and install control valve assembly attaching screws, eliminating detent roller and spring assembly attaching screw. Torque bolts to 8 foot-pounds, Fig. 7-230.

c. Install detent roller and spring assembly and attaching screw. Tighten screw to 8 foot-pounds.

d. Install detent terminal and lead wire to case connector.

e. Install governor feed pipe in transmission case and control valve body.

(NOTE: Make certain that governor feed pipe is seated in bores in case and valve body.)

30j. Pressure Regulator Valve, Intake Pipe and Filter Assembly, Bottom Pan, Modulator Valve and Modulator

1. Install Pressure Regulator Valve

a. Install spring retainer on pressure regulator spring. Also install spacers if previously removed, Fig. 7-231.

b. Install pressure regulator valve on spring, stem end first.

c. Install boost valve into bushing, stem end out, and stack parts so that pressure regulator spring is against valve bushing.

d. Install complete assembly, pressure regulator valve first, into pressure regulator valve bore, being careful not to drop parts during installation.

e. Using a screwdriver or steel rod, compress regulator boost valve bushing against pressure regulator spring until it is beyond snap ring groove, and install snap ring using Snap Ring Pliers, J-5403 (#21), Fig. 7-232.

(NOTE: To facilitate installation of snap ring, encircle it around screwdriver or steel rod, compress tangs with snap ring pliers, and slide snap ring into ring groove in valve bore.)

2. Install Intake Pipe and Filter Assembly and Bottom Pan

a. Install new intake pipe O-ring into pipe bore in transmission case and install intake pipe and filter assembly.

b. Install new bottom pan gasket on transmission case and install bottom pan.

c. Install 13 bottom pan attaching screws. Tighten screws to 12 foot-pounds.

3. Inspect Vacuum Modulator and Valve

a. Inspect vacuum modulator for any signs of bending or distortion.

b. Inspect O-ring seat for damage.

c. Inspect modulator valve for nicks or damage.

d. Check freeness of valve operation in case bore.

e. Check modulator for damaged bellows. Modulator plunger is under approximately 16 pounds pressure. If bellows is damaged, plunger will have very little pressure. Use procedure outlined in Note 3w.

4. Install Modulator Valve and Vacuum Modulator

a. Install modulator valve into case with stem end out.

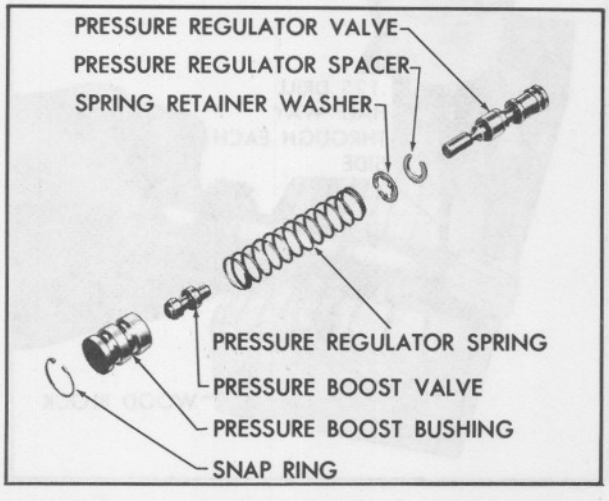


Fig. 7-231 Pressure Regulator Valve - Exploded View

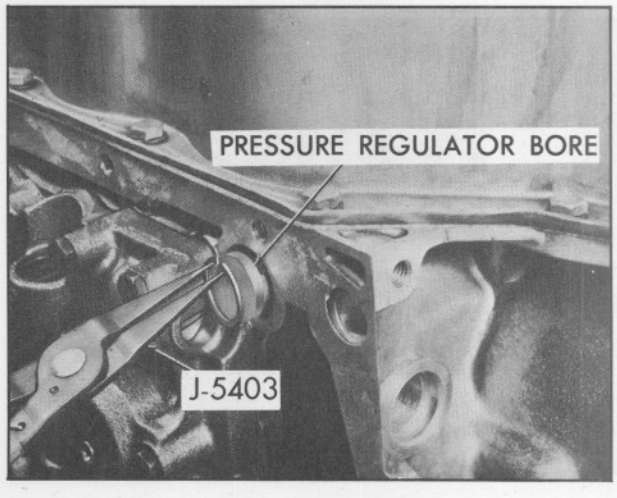


Fig. 7-232 Installing Pressure Regulator Valve

b. Install new O-ring on vacuum modulator.

c. Install vacuum modulator into case with vacuum hose pipe facing case connector.

d. Install modulator retainer with curved side of tangs inboard and install attaching screw. Tighten screw to 18 foot-pounds.

30k. Governor Assembly

(NOTE: All components of the governor assembly, with the exception of the driven gear, are a select fit and each assembly is factory calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.)

1. Governor Inspection

a. Wash in cleaning solvent, and blow out all passages.

b. Inspect governor sleeve for nicks, burrs, scoring or galling.

c. Check governor sleeve for free operation in bore of transmission case.

d. Check governor valve for free operation in bore of governor sleeve.

e. Inspect governor driven gear for nicks, burrs, or damage.

f. Check governor driven gear for looseness in governor sleeve.

g. Inspect speedometer drive gear for nicks, burrs, or damage.

h. Check speedometer drive gear for looseness on governor sleeve.

i. Inspect governor springs for distortion or damage.

j. Check governor weights for free operation in their retainers.

k. Check valve opening at entry and exhaust (.020" minimum).

2. Governor Driven Gear Replacement

To facilitate governor repair in the field, governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

a. Place governor sleeve on a block of wood and drive retaining pin out, using a small punch or 1/8" drill rod.

b. Remove governor driven gear as follows:

(1) Insert governor driven gear in a vice.

(2) Firmly grip governor sleeve with hands and twisting and pulling at the same time, pull governor sleeve away from the governor driven gear.

(3) Discard governor driven gear.

c. Remove governor valve and wash all parts in cleaning solvent and blow off parts.

d. Install governor valve, end with holes last, into governor sleeve.

e. Support governor on 7/64" plates, installed in exhaust slots of sleeve, position new gear in sleeve and with a 7/16" socket, press gear into sleeve until seated. See Fig. 7-233.

f. Place governor sleeve on a block of wood and with a 1/8" drill, drill half way through each side of gear; drill through existing hole. See Fig. 7-234.

g. Install split retaining pin, making sure each end is slightly below top of hole.

CAUTION: Extreme care must be taken to prevent damaging the parts.

h. Stake both ends of pin hole, two places.

i. Thoroughly wash governor assembly in cleaning solvent and blow out all passages.

3. Install Governor

a. Rotate transmission in Holding Fixture Base so that governor bore is up.

b. Install new square cut O-ring seal on governor assembly and install assembly into transmission case, Fig. 7-235.

c. Position retaining clip on top of governor assembly.

4. Inspect Speedometer Driven Gear Assembly

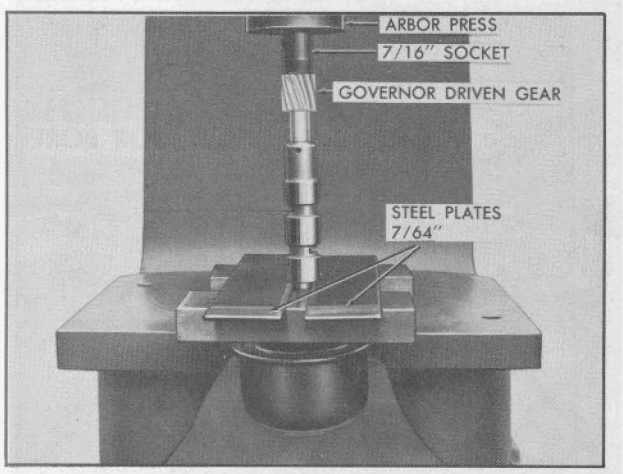


Fig. 7-233 Installing Governor Gear in Sleeve

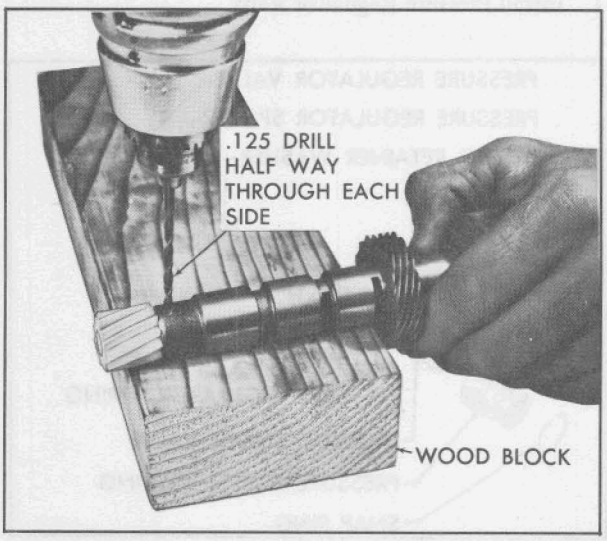


Fig. 7-234 Drilling into Side of Gear

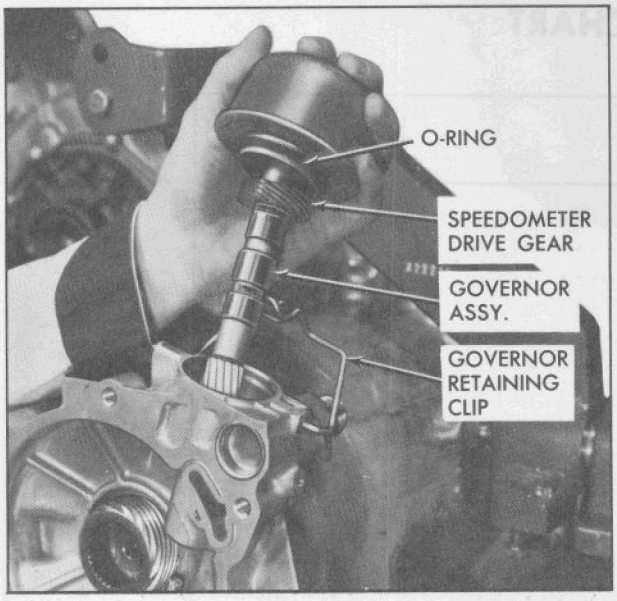


Fig. 7-235 Installing Governor Assembly

a. Inspect gear for damaged teeth or shaft.

b. Inspect sleeve for scores, damaged threads or cracks.

5. Install Speedometer Driven Gear and Speed Control Spark Switch Assembly

a. Install new O-ring seal on speedometer driven gear assembly.

b. Lubricate housing lip seal with a thin coat of lithium (slip yoke) grease.

c. Install speedometer housing and seal assembly and white nylon driven gear into transmission case, Fig. 7-236.

d. Position retaining clip to transmission and driven gear assembly and secure with one attaching bolt, tightening bolt to 6 ft. lbs.

e. Attach speed control spark switch to speedometer driven gear housing by screwing together.

f. Attach speed control spark switch wire to unit.

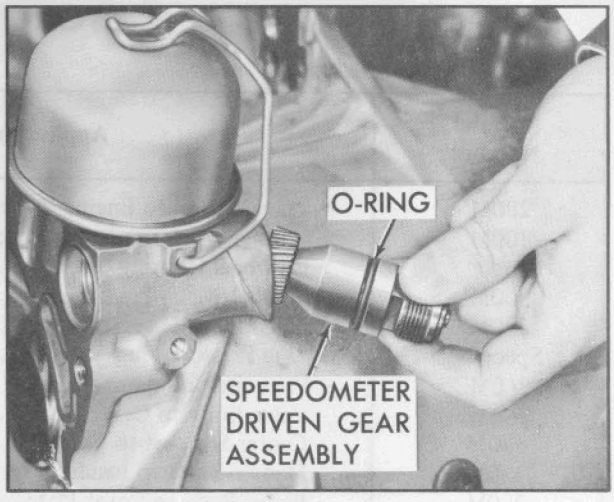


Fig. 7-236 Installing Speedometer Driven Gear

30I. Converter

1. Inspect Torque Converter

a. Check converter for leaks as described in Note 14.

b. Check converter hub surfaces for signs of scoring or wear.

2. Install Torque Converter

a. Position transmission jack with adapter plate to transmission and install transmission on jack using brace and safety chain.

b. Carefully position converter on turbine shaft, making certain converter is properly aligned. Long screws or eyebolts can be threaded into the weld nuts on the converter and used as handles.

c. Rotate converter until the shafts are piloted and the converter lugs are indexed in the pump gear.

d. If difficulty is experienced in alignment, tap on outer diameter of converter with plastic-headed hammer, while turning converter.

e. Install Converter Holding Clamp, J-21366, on transmission case.

f. Remove Transmission Holding Fixture, J-22240, from transmission.

TORQUE CHART

Material Number	Application	Thread Size	Foot Pounds
280M	Transmission to Engine Bolts	3/8–16	25
300M	Torque Converter to Flywheel	3/8–16	30
1010	Flywheel Housing Cover	5/16–18	5
300M	Final Drive to Transmission	3/8–16	25
280M	Solenoid to Case Screw	1/4–20	10
Special	Line Pressure Plug	1/8 Pipe	13
260M	Vacuum Modulator Retainer	5/16–18	18
260M	Valve Body to Case	1/4–20	8
300M	Center Support to Case	3/8–16	23
286M	Manual Shaft to Inside Lever	3/8–24	18
280M	Pump Body to Cover Plate	5/16–18	20
280M	Parking Brake Bracket to Case	5/16–18	18
1010–1020	Oil Pan to Case	5/16–18	12
280M	Sprocket Housing	1/4–20	8
260M	Support Housing to Cover Plate	5/16–18	20
260M	Speedometer Driven Gear Retainer	5/16–18	18

SPECIAL TOOLS

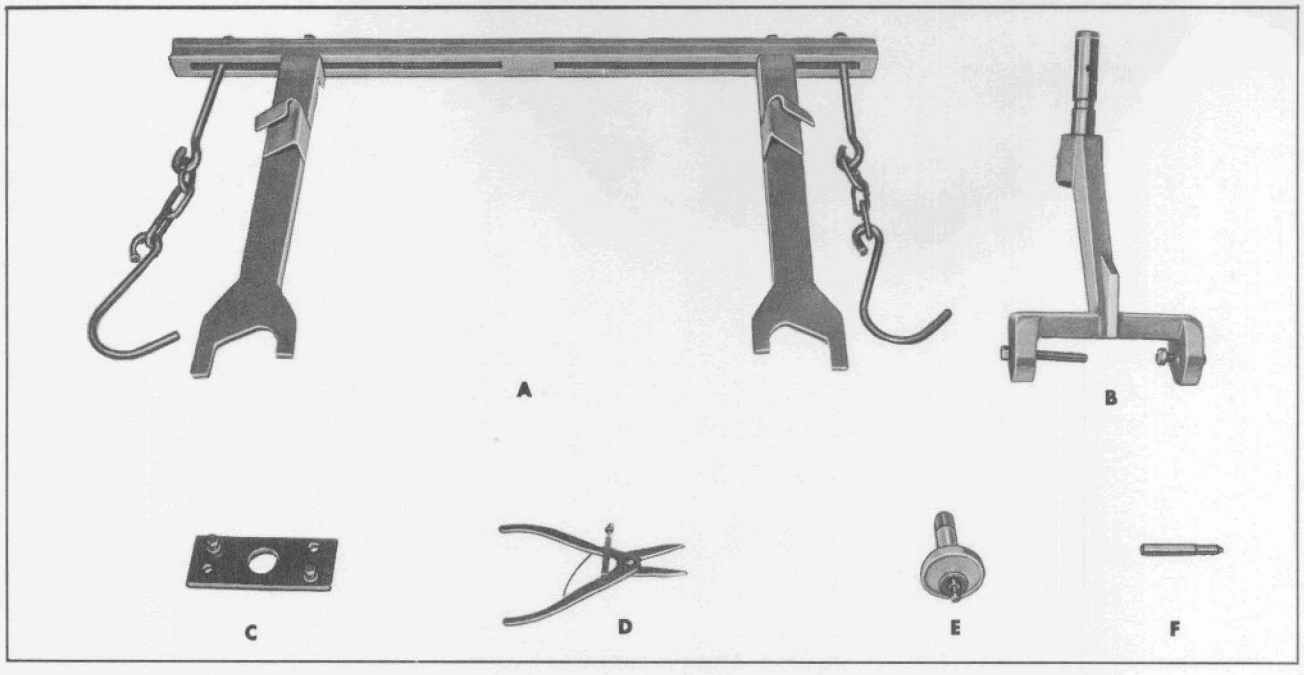


Fig. 7-137 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-22825	Engine Support Fixture	D	J-4646	Snap Ring Pliers
B	J-22240	Transmission Holding Fixture	E	J-22241	Front Unit End Play Checking Tool
C	J-21370-8	Band Apply Adapter Plate	F	J-21370-7	Band Apply Adapter Pin

(NOTE: The above Special Tools are required in addition to most tools shown in Fig. 7-125 to properly overhaul the Turbo Hydra-matic transmission used on the Eldorado.)

FUEL SYSTEM

GENERAL DESCRIPTION

The fuel tank on all 1972 Cadillac cars is mounted at the rear of the car under the trunk compartment with two support straps.

The fuel tank capacity is approximately 27-1/2 U.S. gallons (23 Imperial gallons) on all models.

All Cadillac vehicles are equipped with a system to prevent evaporation of fuel from the tank. Complete information on this system is found in Section 6, Page 6- .

The gasoline filler cap is located behind the rear license mounting plate, which is the filler door. The hinged plate swings out from the top. The filler pipe is an integral part of the fuel tank on all cars except the 698 series.

The filler cap is a pressure-vacuum (PV) type on all models. For a complete description of the fuel tank vent system, refer to the Emission Control Systems, Section 6, Page 6-84.

The tank unit for the gasoline gage is mounted near the top center of the fuel tank. It contains the float unit, which is connected to the gage unit on the instrument panel by one wire, with another wire to ground. The fuel outlet line is integral with the tank float unit assembly. It has a special plastic filter (water separator) on the inlet end. The filter has a self-cleaning action, provided by the sloshing action of the gasoline.

The fuel outlet line is attached to the gage assembly on the top center of the tank and extends along the inside of the right frame side rail and crosses in front of the front suspension cross member to the fuel pump, Fig. 8-1.

SERVICE INFORMATION—FUEL SYSTEM

The following caution applies to one or more procedures in this section as indicated at appropriate locations by the terminology *"Refer to CAUTION on Page 8-1".*

CAUTION: When working on or around the fuel tank always have a CO_2 fire extinguisher near the work area. In addition, do not permit any smoking, open fire or work of a nature that could produce a spark in the area.

1. Storage Precautions

Whenever a car is to be put in storage for 30 days or longer, all gasoline should be removed from the fuel tank. Disconnect all fuel lines, blow out and reconnect. Remove carburetor, clean thoroughly and store in plastic bag. Remove fuel pump, clean and store with carburetor. Remove filter assembly and discard. Tape all openings closed. This must be done to assure freedom from gum deposits that would occur due to evaporation of the fuel.

2. Fuel Tank

(Refer to CAUTION on Page 8-1.)

a. Removal

1. Disconnect battery, Open fuel tank filler door and disconnect sending unit (tan) feed wire.
2. Drain fuel from tank by syphoning and pumping gasoline out through fuel line using a gas hand truck pump or 12 volt electric pump.
3. Raise car.
4. Remove screw securing ground wire to cross member.
5. Disconnect fuel line and evaporative loss control system lines at front of tank. If car is equipped with air conditioning, remove vapor return line. Plug all disconnected lines.
6. Support tank with jack and wood block and remove one screw, each side, securing fuel tank support straps to body at front of tank.
7. Lower jack with fuel tank and remove tank.

b. Installation

1. Position tank to underbody; position fuel tank support straps under tank and loosely install screws securing straps to body.
2. Secure ground wire to rear cross member.
3. Tighten tank strap screws until bottomed. Torque to 25 ft. lbs.
4. Connect fuel lines and evaporative loss control system lines. If car is equipped with air conditioning, connect vapor return line.
5. Lower car.
6. With fuel filler door open, connect sending unit (tan) feed wire.
7. Replace drained fuel in tank.

3. Fuel Line and Tank Cleaning

(Refer to CAUTION on Page 8-1.)

Occasionally it may be necessary to clean out fuel line and tank to remove foreign particles from system. Frequent replacement of fuel filters and excessive deposits of dirt in the fuel inlet strainer are indications that this may be necessary.

a. Fuel Line

To clean out fuel line, disconnect line at fuel pump and at fuel tank, blow compressed air through the line in direction opposite to fuel flow, and reconnect line.

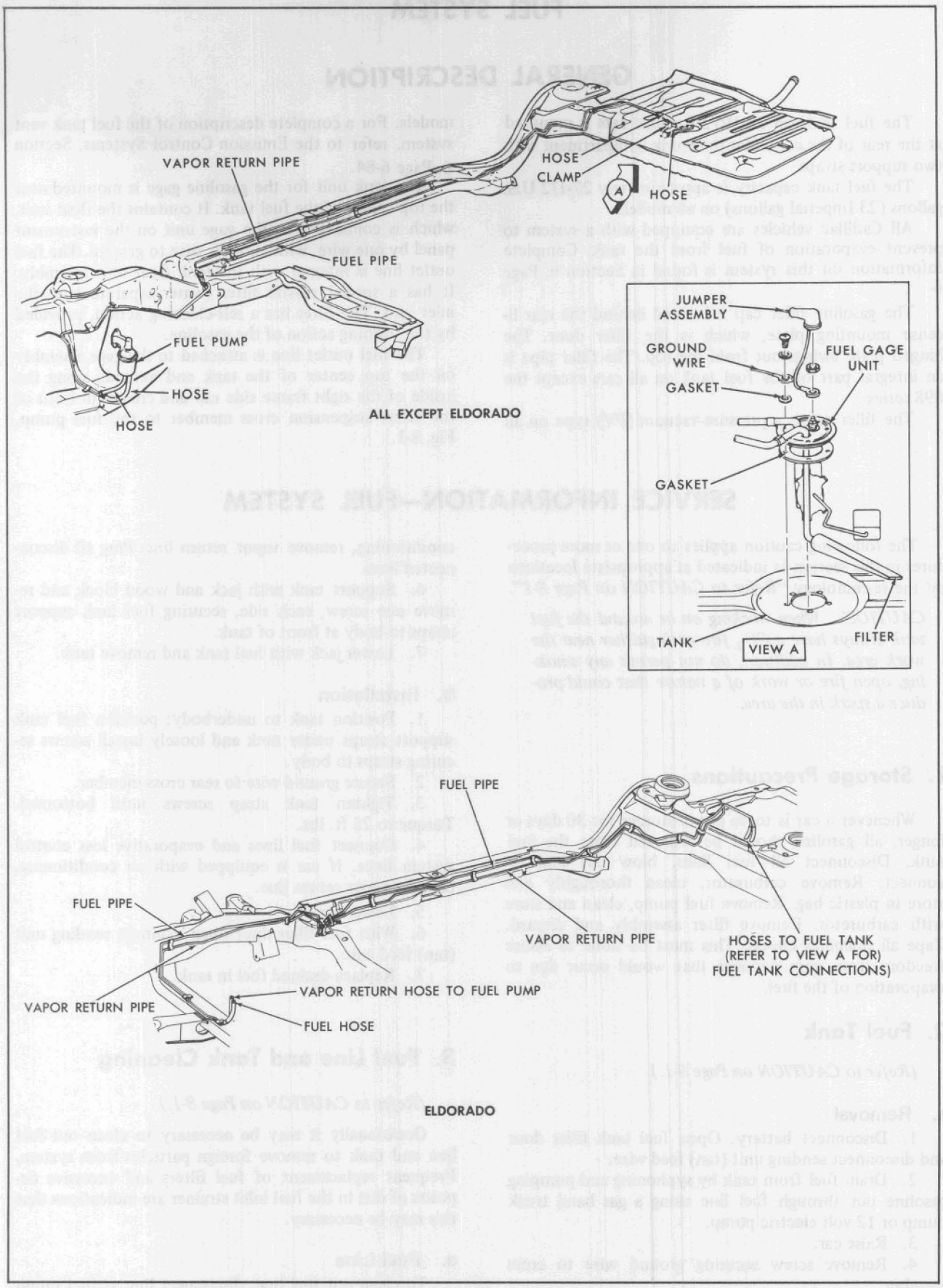


Fig. 8-1 Fuel Lines and Tank

b. Fuel Tank

For cleaning fuel tank, tank must be removed from car and flushed out to remove all foreign materials. Fuel strainer also should be inspected and replaced if necessary.

(NOTE: If trouble is due to contaminated fuel or foreign material that has been put into the tank, it can usually be cleaned. If tank is rusted internally, it should be replaced.)

1. Disconnect battery and ignition coil primary wire (plus wire on ignition coil).
2. Drain fuel tank by syphoning and pumping gasoline out through fuel line using a gas hand truck pump or 12 volt electric pump.
3. Remove fuel tank as described in Note 2a.
4. Locate tank away from heat, flame, or other source of ignition. Remove fuel gage unit from tank and inspect condition of filter. If filter is contaminated, a new filter should be installed upon reassembly.
5. Complete draining of tank by rocking it and allowing fuel to run out one of the front corner vent pipes.
6. Purge fuel tank with steam or running hot water for at least five minutes. Pour water out of tank unit hole (rock tank to assure complete removal of water).

CAUTION: This procedure will not remove fuel vapor. Do not attempt any repair on tank or filler neck where heat or flame is required.

7. Disconnect inlet fuel line at pump and use air pressure to clean fuel line and vapor return line (if equipped). Apply air pressure through line in the direction opposite to normal fuel flow.
8. Use low air pressure to clean pipes on tank unit.
9. Install new filter on fuel gage unit, if required. Install fuel gage unit with new gasket into tank and install tank as described in Note 2b. Connect tank unit wires and all fuel lines.
10. Disconnect fuel line at carburetor, connect a hose to fuel line and insert other end of hose into a one gallon fuel can.
11. Connect battery cable. Make sure ignition coil primary wire is disconnected.
12. Put six gallons of clean fuel in tank and operate starter to pump two quarts of fuel into fuel can. This will purge fuel pump.
13. Remove hose and connect fuel line to carburetor.
14. Connect coil primary wire.

4. Fuel Line

(Refer to CAUTION on Page 8-1.)

a. Removal

1. Raise car.
2. Remove clamps securing flexible fuel line to fuel tank outlet and to fuel pump and disconnect lines at these points.
3. Tie a piece of cord to the flexible fuel lines for installation purposes. (Cord will be left with car after lines are removed.)
4. Plug hoses to prevent fuel loss.
5. Remove clips securing fuel line to right frame side rail.
6. Carefully remove fuel lines from car, leaving cord in place on car.
7. Remove clamps securing flexible fuel line to fuel pipe and separate.

b. Installation

1. Connect flexible fuel line to steel fuel pipe and secure with clamps. Hoses should overlap steel line one inch.
2. Position fuel pipe to surface of right frame side rail and secure with clips.
3. Tie cords left in car to ends of flexible lines and carefully pull fuel lines to tank and engine.
4. Remove cords.
5. Unplug lines.
6. Connect flexible lines at tank and engine and secure with clamps.
7. Lower car.

EXHAUST SYSTEM
GENERAL INFORMATION

(NOTE: Service information pertaining only to those features that are exclusive to the Eldorado exhaust system is included at the end of this section, beginning on page 8-6.)

a. Exhaust System Design

The exhaust system on all Cadillac cars, except the Eldorado incorporates (in order from front to rear), a crossover Y-exhaust pipe, an intermediate pipe, a muffler and a muffler-to-resonator pipe with integral resonator, Fig. 8-2. On the Sixty Special Brougham, Fleetwood Seventy-Five, and Commercial Chassis, a longer intermediate pipe is used because of the additional length of these vehicles.

The components of the exhaust system are supported by slide and blade-type hangers, clamps, and brackets, and are insulated at attaching points by rubber cushions. These supports are designed to keep the system in proper alignment to avoid contact with the frame and body, even when the system is hot and expanded. The system must not be bound up or restricted if the noise reduction benefits are to be fully realized.

b. Exhaust System Service

Whenever a change is noticed in the sound of the exhaust system, or when exhaust gas can be detected inside the vehicle, inspect the complete exhaust system for broken or damaged parts, deterioration, broken seams or loose connections which may cause leaks. In addition, inspection for these conditions should be per-

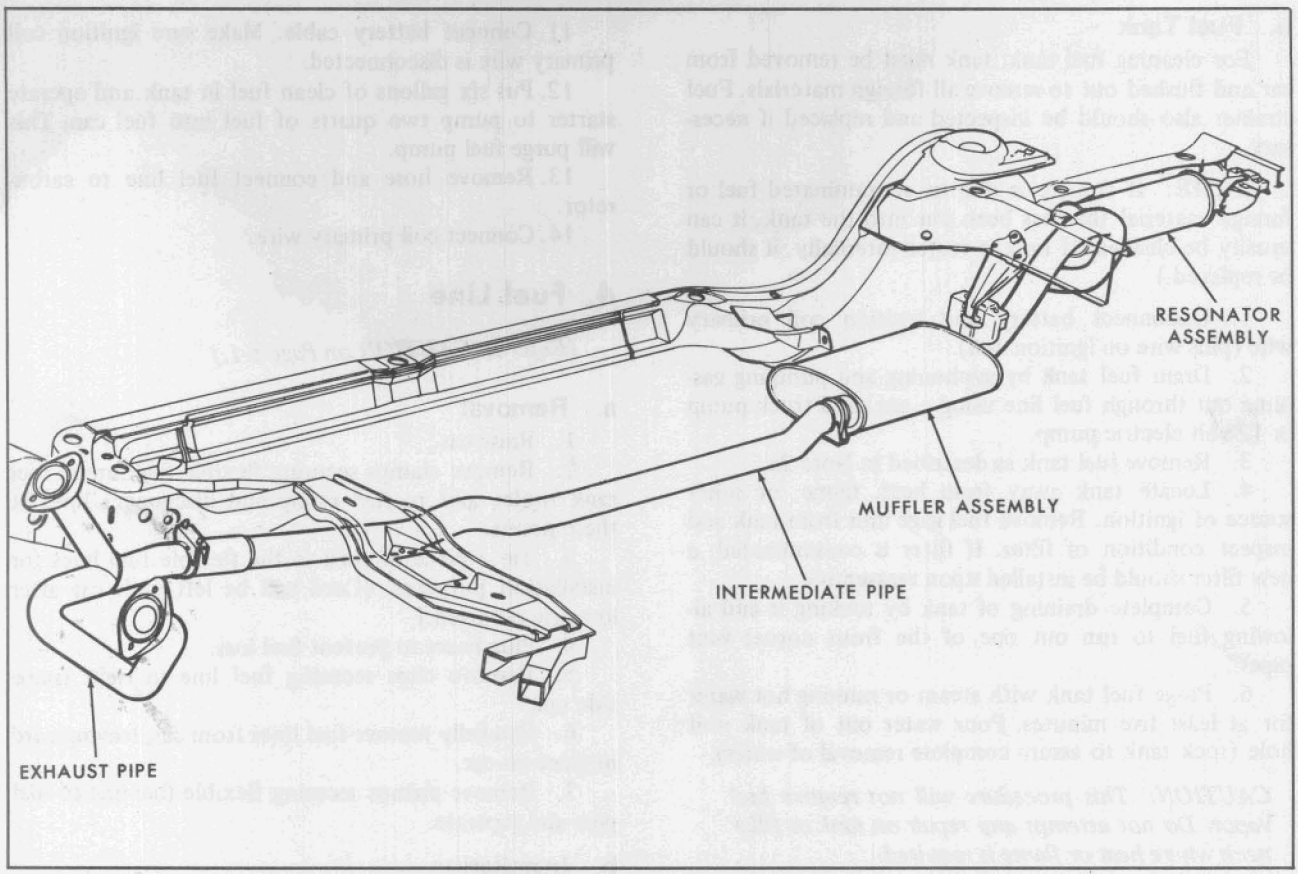


Fig. 8-2 Exhaust System - Except Eldorado

formed every 4 months, never to exceed 6,000 miles.

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Make sure that exhaust system components have at least 3/4 inch clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to the passenger compartment carpets.

SERVICE INFORMATION—EXHAUST SYSTEM

5. Exhaust Pipe (Except 693)

CAUTION: Have a CO_2 fire extinguisher near work area when using heat.

a. Removal

1. Raise car.
2. Remove two nuts securing pipes to each exhaust manifold.
3. Remove clamp securing exhaust pipe to intermediate pipe.
4. Allow exhaust pipe to drop and drive exhaust pipe forward out of intermediate pipe. Use heat as required.

b. Installation

1. Insert exhaust pipe into intermediate pipe so that locating key bottoms in slot.
2. Raise exhaust pipe and secure to manifolds. Align system and tighten nuts to 30 ft.-lbs.
3. Secure exhaust pipe to intermediate pipe with clamp. Position clamp so that saddle of clamp is 1/8 inch in from edge of pipe and nuts point upward, Fig. 8-3. Leave nuts loose.
4. Align system, as outlined in Note 9, and tighten clamp nuts to 50 ft. lbs.
5. Lower car.

6. Intermediate Pipe

CAUTION: Have a CO_2 fire extinguisher near work area when using heat.

a. Removal

1. Raise car.
2. Remove clamp securing muffler to intermediate pipe.
3. Slide muffler off intermediate pipe. Use heat as required.
4. Remove clamp securing intermediate pipe to exhaust pipe.

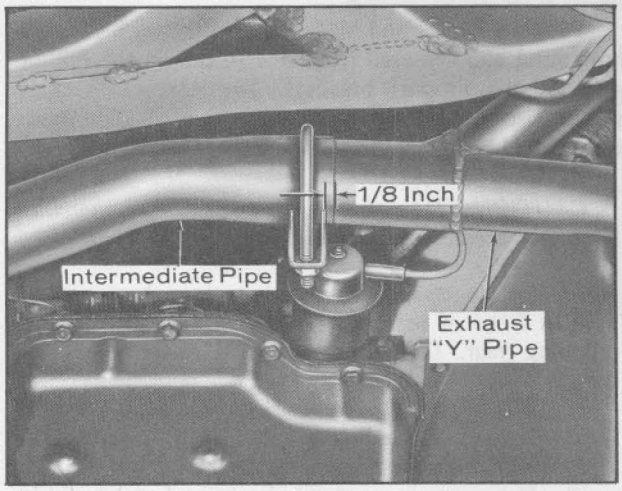


Fig. 8-3 Intermediate Pipe at Exhaust Pipe

b. Installation

1. Slide intermediate pipe over exhaust pipe so that locating key bottoms in slot.
2. Secure intermediate pipe to exhaust pipe with clamp. Position clamp with saddle of clamp 1/8 inch from end of pipe and leave nuts loose.
3. Insert intermediate pipe into muffler approximately 1-1/2 inches. Position clamp with saddle of clamp 1/8 inch in from edge of pipe toward left side of car, Fig. 8-4.
4. Align system, as described in Note 9, and tighten muffler clamp nuts to 35 foot-pounds and exhaust pipe clamp nuts to 50 foot-pounds.
5. Lower car.

7. Muffler (Except 693)

CAUTION: Have a CO_2 fire extinguisher near work area when using heat.

a. Removal

1. Raise car.
2. Loosen resonator hanger clamp and remove hanger blade.
3. Remove two nuts securing clamp at front of muffler to exhaust pipe and remove clamp, Fig. 8-4.
4. Remove two nuts securing rear clamp to muffler and remove clamp, Fig. 8-5.
5. Slide rear portion of exhaust system back off intermediate pipe. Use heat as required.
6. Drive muffler off muffler-to-resonator pipe. Use heat as required.

b. Installation

(NOTE: Exhaust pipes and resonator rearward of muffler should be replaced whenever a new muffler is installed.)

1. Position muffler onto muffler-to-resonator pipe so that muffler outlet overlaps pipe approximately 1-1/2 inches.
2. Insert intermediate pipe into muffler inlet approximately 1-1/2 inches.

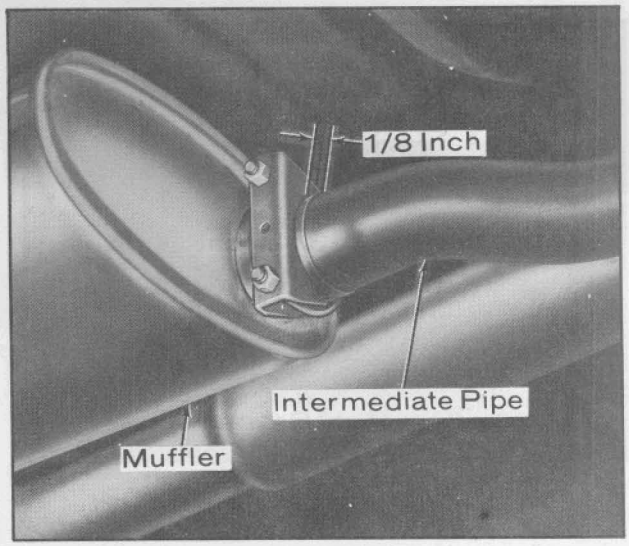


Fig. 8-4 Intermediate Pipe at Muffler

3. Install muffler-to-resonator pipe hanger. Position hanger with saddle of clamp 1/8 inch in from edge of pipe, Fig. 8-5.
4. Install clamp to front of muffler as shown in Fig. 8-4. Do not tighten clamp.
5. Align exhaust system as described in Note 9.
6. Lower car.

8. Resonator (Except 693)

a. Removal

1. Raise car.

(NOTE: Support muffler to avoid damage to exhaust system.)

2. Remove two nuts securing clamp at rear of muffler and remove clamp.
3. Remove rear exhaust hanger at resonator outlet.
4. Separate resonator to muffler pipe from muffler.

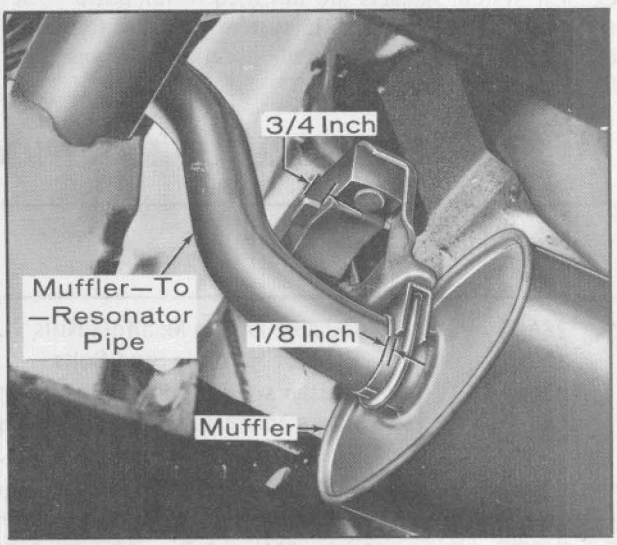


Fig. 8-5 Muffler Outlet Clamp and Hanger

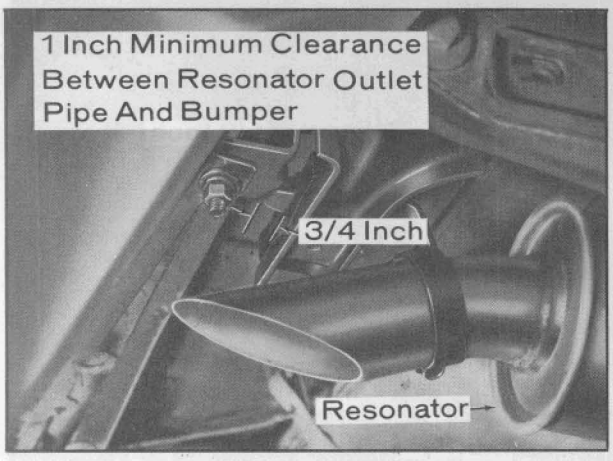


Fig. 8-6 Resonator Outlet Pipe and Hanger

5. Remove resonator and pipe by working pipe over rear axle.

CAUTION: Do not use heat behind rear axle.

b. Installation

1. Install resonator and pipe over rear axle.
2. Install pipe into muffler outlet.
3. Loosely install exhaust hanger at resonator outlet, Fig. 8-6.
4. Loosely install two nuts, clamp and hanger at rear of muffler, Fig. 8-5.
5. Align exhaust system as described in Note 9, and tighten clamps.
6. Remove support from muffler, and lower car.

9. Exhaust System Alignment (Except 693)

CAUTION: Have CO_2 fire extinguisher near the work area.

(NOTE: Exhaust system should be properly aligned to avoid contact with frame or floor pan. Blade-type exhaust system hangers are designed to minimize noise transfer through hangers. If system contacts frame or blade is bound up or restricted, vibration and noise can be transmitted into car.)

Position clamps and blades so that hanger blades are horizontal and centered from side to side in the rubber slots of the support brackets. The support brackets should also be horizontal. A light coat of silicone lubricant should be applied in rubber slots of brackets.

CAUTION: Do not use petroleum base products, such as grease, on the rubber parts.

If it is necessary to reposition pipes, heat may be used in front of rear axle. Allow pipes to cool before touching them. Do not use acetylene torch behind rear axle.

1. Raise car.
2. Loosen clamps located at front of intermediate pipe, muffler ends, and resonator outlet.
3. Make certain system is horizontal and has adequate clearances.
4. Position intermediate pipe to exhaust pipe so there is approximately 1/8 inch between saddle of clamp and edge of intermediate pipe, Fig. 8-2. Tighten clamp to 50 foot-pounds.
5. Position clamp between intermediate pipe and muffler so there is approximately 1/8 inch between edge of muffler inlet pipe and saddle of clamp, Fig. 8-4. Tighten clamp just enough to prevent separation. Then check alignment of remainder of exhaust system.
6. Position clamp between muffler outlet pipe and muffler-to-resonator pipe so there is approximately 1/8 inch between edge of muffler outlet pipe and saddle of clamp, Fig. 8-5. There should be approximately 1-1/2 inch overlap of outlet pipe with muffler-to-resonator assembly.
7. Align resonator assembly to muffler so there is a minimum of one inch between outlet pipe and rear frame cross member, when measured perpendicular to the angle of pipe at outlet, Fig. 8-6.
8. Check entire system again to see that there is adequate clearance with frame and body members - at least one inch (except 1/2" at frame rear cross member.) Make sure that exhaust system components have at least 3/4 inch clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to the passenger compartment carpets. The weight of the exhaust system should be evenly distributed on all brackets and hangers as indicated by an equal deflection at each

TORQUE SPECIFICATIONS (Except 693)

Material Number	Application	Thread Size	Foot-Pounds
286-M	Exhaust Pipe to Manifold Nuts	3/8-24	30
300-M	Exhaust Manifold Stud Bolts	3/8-24	35
286-M	Muffler and Resonator Clamp Nuts . . .	3/8-16	35
286-M	Intermediate Pipe to Exhaust Pipe Clamp Nuts	7/16-24	50
6010-M	Resonator Outlet Pipe Hanger Screw . .	20-9	10

(NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings and steel classifications.)

hanger rubber. If the load is not properly balanced, reposition the pipes at the joints to relieve concentrated loads on any hangers.

9. After adjusting hangers or repositioning pipes, recheck the entire system for adequate clearance to frame members and floor pan and tighten all clamps according to torques specified in the chart on Page 8-6.

10. Lower car.

GENERAL DESCRIPTION—ELDORADO EXHAUST SYSTEM

(NOTE: The following information pertains only to those features that are exclusive to the Eldorado exhaust system.)

The exhaust system on the 693 body style, Fig. 8-7, consists of two exhaust pipes, an exhaust "Y" pipe, a muffler, and a resonator assembly. The system is supported to the frame by blade-type hangers, one at the muffler outlet and one on the resonator outlet. The forward portion of the system is supported by its connection to the exhaust manifolds.

CAUTION: If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly or failure include the exhaust system, shock absorber, springs, suspension control arms, stabilizer bar, power steering pump hoses and transmission cooler pipes.

SERVICE INFORMATION—ELDORADO EXHAUST SYSTEM

10. Exhaust Pipe—Right or Left (693 Only)

CAUTION: Have a CO_2 fire extinguisher near work area when using heat.

a. Removal

1. Raise car.
2. Remove clamp securing exhaust pipe to "Y" pipe at side to be removed, Fig. 8-8.
3. Remove two nuts securing exhaust pipe to manifold and disengage pipe from manifold.
4. Twist and rock exhaust pipe to disengage it from "Y" pipe.

b. Installation

1. Insert rear portion of exhaust pipe into forward portion of "Y" pipe.
2. Position exhaust pipe to exhaust manifold and loosely install two nuts to manifold studs

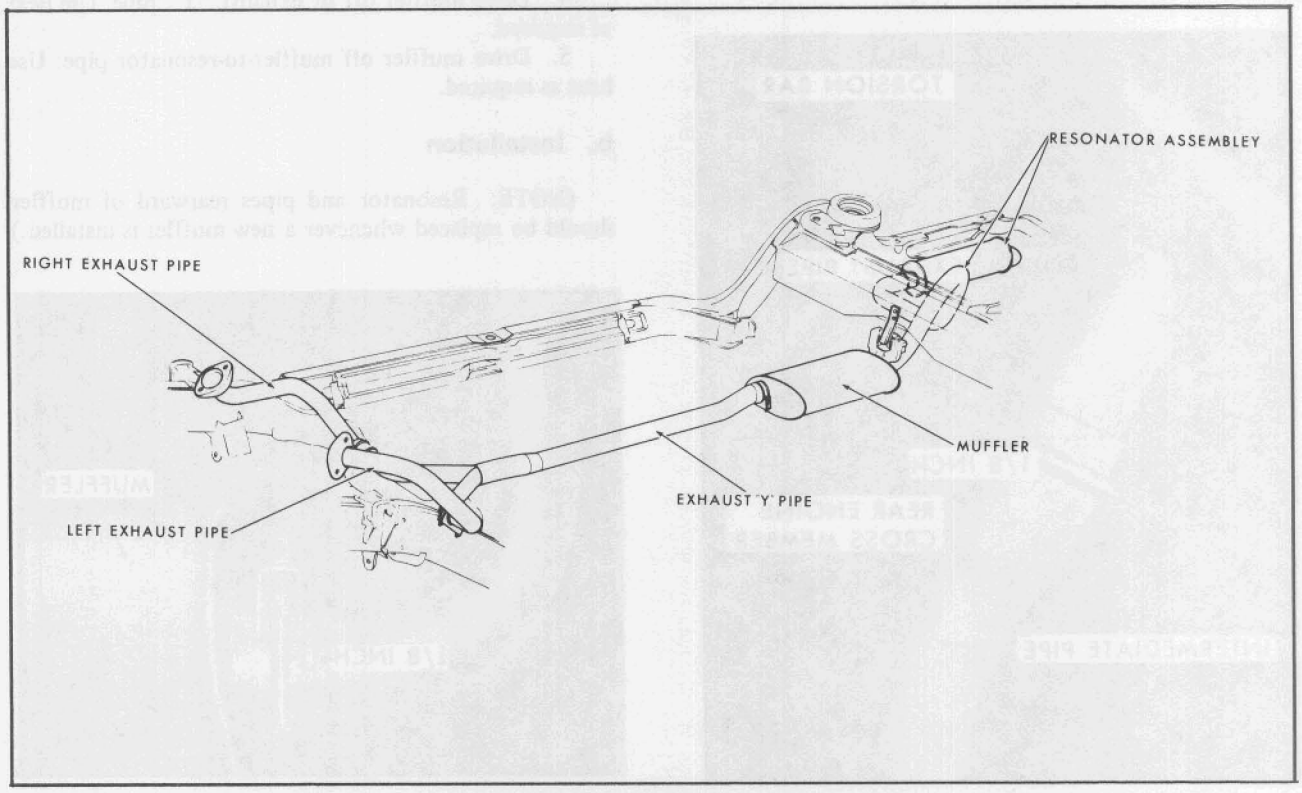


Fig. 8-7 Eldorado Exhaust System

3. Reposition rear of exhaust pipe so that pipes overlap about 1-1/2 inches. Loosely install clamp with saddle of clamp outboard of system and with 1/8 inch between saddle of clamp and edge of pipe, Fig. 8-8.

4. Align exhaust system as described in Note 14, and tighten manifold nuts to 30 foot-pounds.

5. Lower car.

11. Exhaust "Y" Pipe (693 Only)

CAUTION: Have a CO_2 fire extinguisher near the work area when using heat.

a. Removal

1. Raise car.
2. Remove one exhaust pipe from one side as described in Note 10a.
3. Remove clamp securing "Y" pipe to exhaust pipe at opposite side.
4. Remove clamp securing "Y" pipe to muffler inlet and drive muffler off of "Y" pipe, Fig. 8-9. Use heat as required.
5. Remove "Y" pipe from exhaust pipe by twisting and rocking motions.

b. Installation

1. Slide "Y" pipe into muffler about 1-1/2 inches, Fig. 8-9.
2. Position "Y" pipe to exhaust pipe remaining in car.
3. Install opposite side exhaust pipe as described in Steps 1 through 3 of Note 10b.
4. Position all clamps 1/8 inch in from edge of overlapping pipe, snug but not tight.
5. Align system as described in Note 14.
6. Lower car.

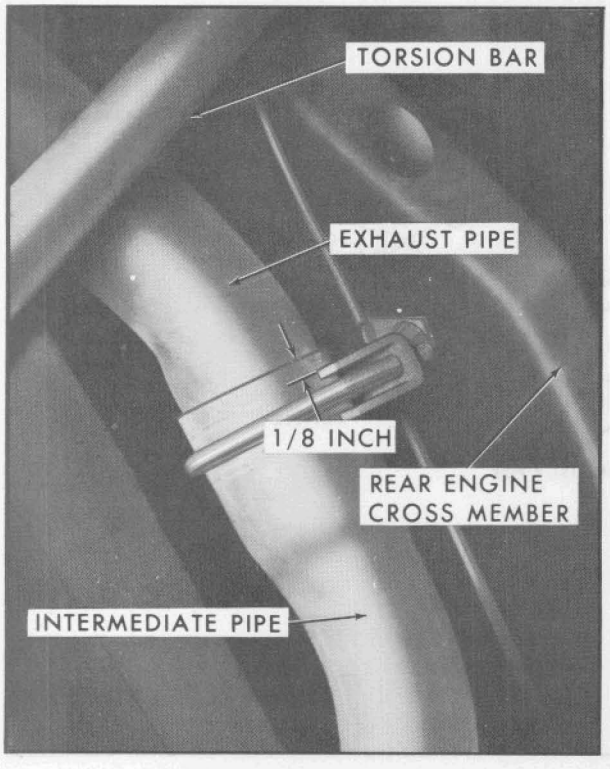


Fig. 8-8 Exhaust Pipe at "Y" Pipe

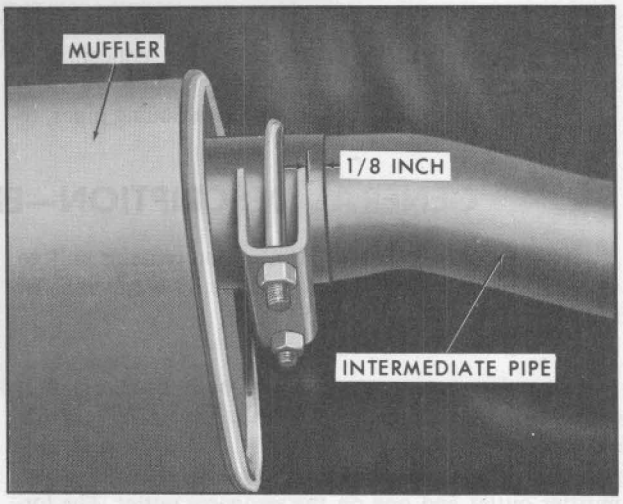


Fig. 8-9 Intermediate Pipe at Muffler

12. Muffler (693 Only)

CAUTION: Have a CO_2 fire extinguisher near the work area when using heat.

a. Removal

1. Raise car.
2. Remove two nuts securing clamp at front of muffler to exhaust "Y" pipe and remove clamp, Fig. 8-9.
3. Remove two nuts from clamp at rear of muffler and remove clamp. Disengage hanger, Fig. 8-10.
4. Drive muffler off of exhaust "Y" pipe. Use heat as required.
5. Drive muffler off muffler-to-resonator pipe. Use heat as required.

b. Installation

(NOTE: Resonator and pipes rearward of muffler should be replaced whenever a new muffler is installed.)

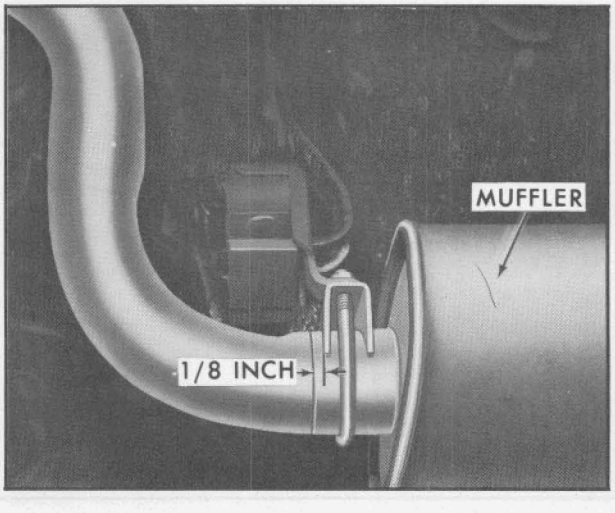


Fig. 8-10 Muffler Outlet Clamp and Hanger

1. Position muffler onto muffler-to-resonator pipe so that muffler outlet overlaps pipe approximately 1-1/2 inches.
2. Insert exhaust "Y" pipe into muffler inlet approximately 1-1/2 inches.
3. Install muffler-to-resonator pipe clamp. Position clamp with saddle of clamp 1/2 inch in from edge of pipe and toward left side of car, Fig. 8-10. Do not tighten nuts.
4. Engage muffler-to-resonator pipe hanger blade with slot in hanger so that blade sticks out from hanger 3/4 inch, Fig. 8-10.
5. Install muffler to exhaust "Y" pipe clamp. Position clamp with saddle of clamp 1/8 inch in from edge of pipe and toward left side of car, Fig. 8-9.
6. Align exhaust system as described in Note 14.
7. Lower car.

13. Resonator Assembly (693 Only)

CAUTION: Do not use heat behind rear axle due to closeness of fuel system.

a. Removal

1. Raise car.
2. Remove clamp securing front of muffler-to-resonator pipe to muffler. Remove hanger cushion from hanger blade, Fig. 8-10.
3. Remove clamp at resonator outlet pipe, Fig. 8-11.
4. Drive muffler-to-resonator pipe out of muffler. Support muffler with a section of wire.
5. Twist pipe over axle and remove assembly.

b. Installation

1. Position muffler-to-resonator pipe into muffler outlet so that muffler overlaps pipe about 1-1/2 inches.
2. Install blade of muffler hanger through slot in cushion so that blade comes through about 3/4 inch and loosely install clamp to hanger, Fig. 8-10.
3. Position resonator outlet hammer blade under clamp at rear of resonator, Fig. 8-11. Do not tighten clamp.
4. Align exhaust system as described in Note 14.
5. Lower car.

14. Alignment—Eldorado Only

Position clamps and blades so that hanger blades are horizontal and centered from side to side in rubber slots of the support brackets. The support brackets should also be horizontal. A light coat of silicone should be applied in rubber slots of brackets. The hangers must not bind when exhaust system expands.

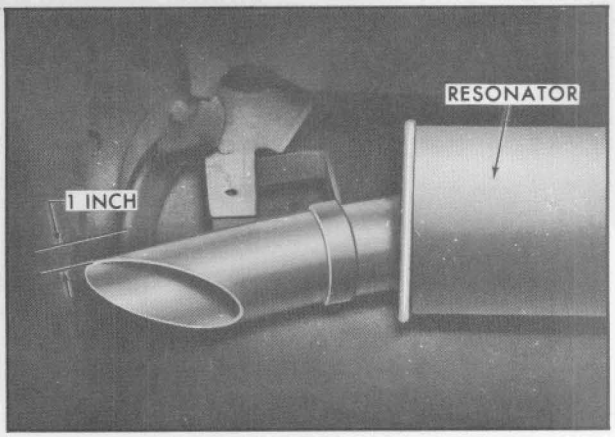


Fig. 8-11 Muffler Outlet Pipe and Hanger

CAUTION: Do not use petroleum base products, such as grease, on the rubber parts.

1. Raise car.
2. Loosen clamps located at muffler outlet and resonator outlet.
3. Check hangers. Ends of hangers should stick out 3/4 inch from brackets. The muffler should overlap all pipes approximately 1-1/2 inch. The clamps should be positioned with 1/8 inch between the saddle of clamps and muffler pipes.
4. Make certain that resonator is horizontal and that it has a minimum of 3/4 inch clearance from fuel tank.
5. The entire system should be checked to see that there is adequate clearance to frame and body members, at least 13/16 inch. Make sure that exhaust system components have at least 3/4 inch clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to the passenger compartment carpets. The weight of the system should be evenly distributed on all brackets and hangers as indicated by an equal deflection at each hanger. If load is not properly balanced, reposition the pipes at the joints to relieve any concentrated loads.
6. After adjusting hangers or repositioning pipes, recheck entire system for adequate clearance and tighten all clamps according to torques specified in the chart on page 8-9.
7. Lower car.

TORQUE SPECIFICATIONS (693 ONLY)

Material Number	Application	Thread Size	Foot-Pounds
Special	Exhaust Pipe to Manifold Nuts	3/8-24	30
286-M	Clamp Attaching Nuts	5/16-18	20
6010-M	Resonator Outlet Pipe Screw	20-9	10



GENERAL DESCRIPTION

Service information pertaining only to those features that are exclusive to the Eldorado steering is included at the end of this section, beginning on page 9-56.

A constant ratio steering gear (17.5:1) is used on Fleetwood Seventy-Fives and commercial vehicles. Variable ratio power steering is utilized on all other 1972 Cadillacs (16.0:1 on center, 13.0:1 at full turn).

Variable ratio steering is accomplished by a pitman shaft sector incorporating a short tooth on either side of a long center tooth, rather than a sector with three teeth of equal length as in constant ratio steering.

The steering gear is mounted on the left frame side rail and is secured by three mounting screws. The gear is joined to the steering shaft by a flexible coupling that reduces the transmission of hydraulic valve noises and road shock to the car interior.

A constant displacement vane type pump provides hydraulic pressure for the steering system. The pump is located on the left front corner of the engine, Fig. 9-1, and is belt driven by an engine crankshaft pulley.

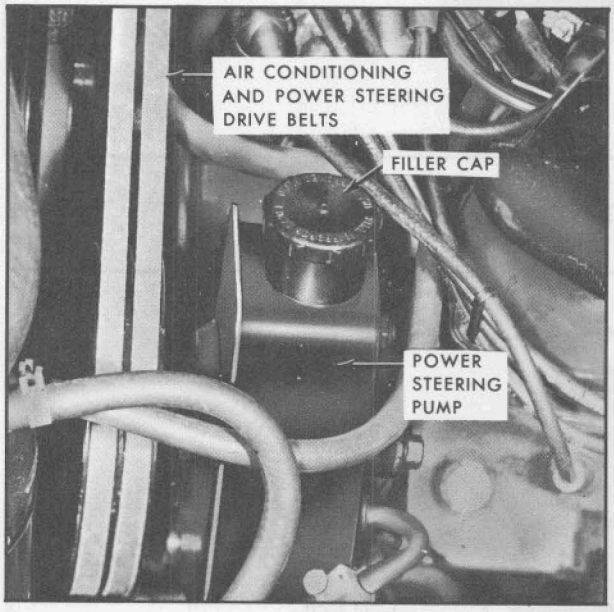


Fig. 9-1 Steering Pump Location

On cars equipped with air conditioning, two belts are used on the power steering pump pulley. On cars without air conditioning, one belt is used.

On all 1972 Cadillacs equipped with air conditioning, the gear to pump return line also serves as a fiuid cooler. It extends across the car before returning to the pump to provide sufficient cooling surface.

The cooler compensates for the slightly higher temperatures on cars equipped with air conditioning and protects the rubber components of the system from excessive temperatures under extreme operating conditions.

Steering Linkage (Except 693)

The steering linkage, Fig. 9-2 consists of a pitman arm, idler arm and bracket, two tie rod assemblies, and a one-piece forged steel drag link. The pitman arm connects the left side of the drag link to the steering gear and the idler arm and bracket assembly connect the right side of the drag link to the frame. The tie rods serve as connecting links between the drag link and steering arms.

The tie rod adjuster tubes are lubricated at assembly to make toe-in adjustment easier during front wheel alignment. The adjuster tubes should be re-lubricated with chassis lubricant if disassembled from the tie rods for any reason.

All 1972 cars are fitted with replaceable tie rod end seals. The seals should be inspected at each engine oil change for signs of physical damage. Special spherical joint lubricant should be used when a seal is replaced. If a tie rod pivot is loose, the complete pivot assembly must be replaced.

Steering Gear

The major internal components of the variable ratio steering gear are the rotary valve assembly steering worm, rack-piston assembly, and the pitman shaft, Fig. 9-3. The movement of these parts, while turning or parking, is aided by hydraulic pressure supplied by the

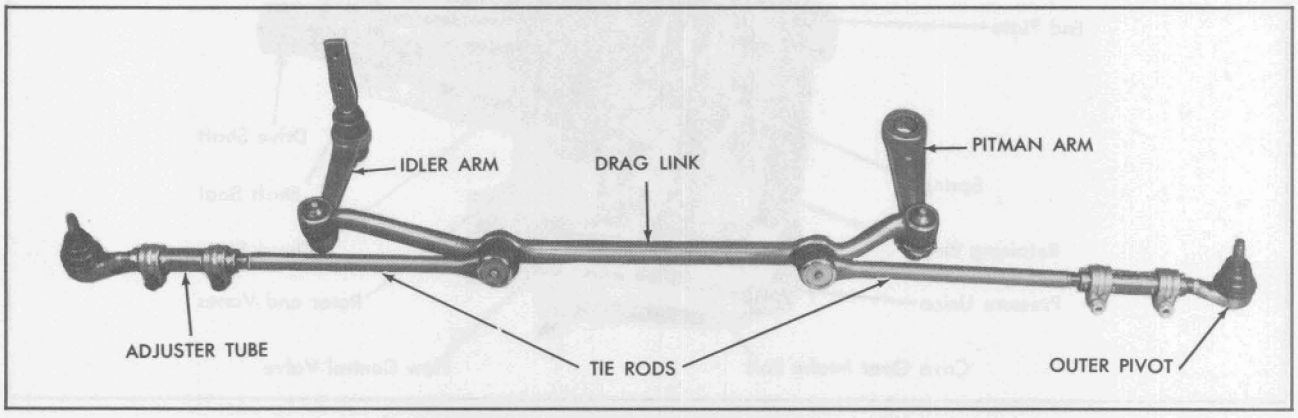


Fig. 9-2 Steering Linkage

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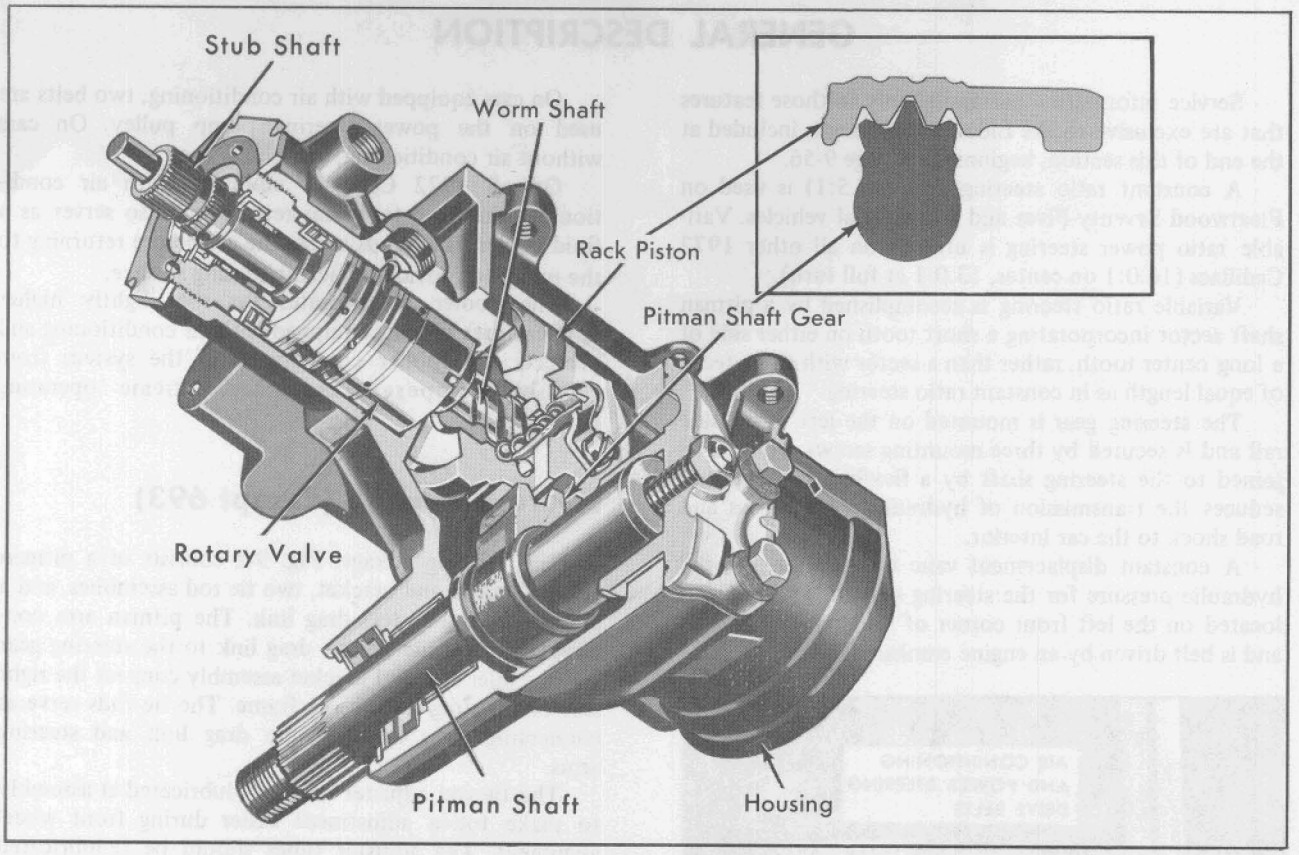


Fig. 9-3 Steering Gear Cutaway

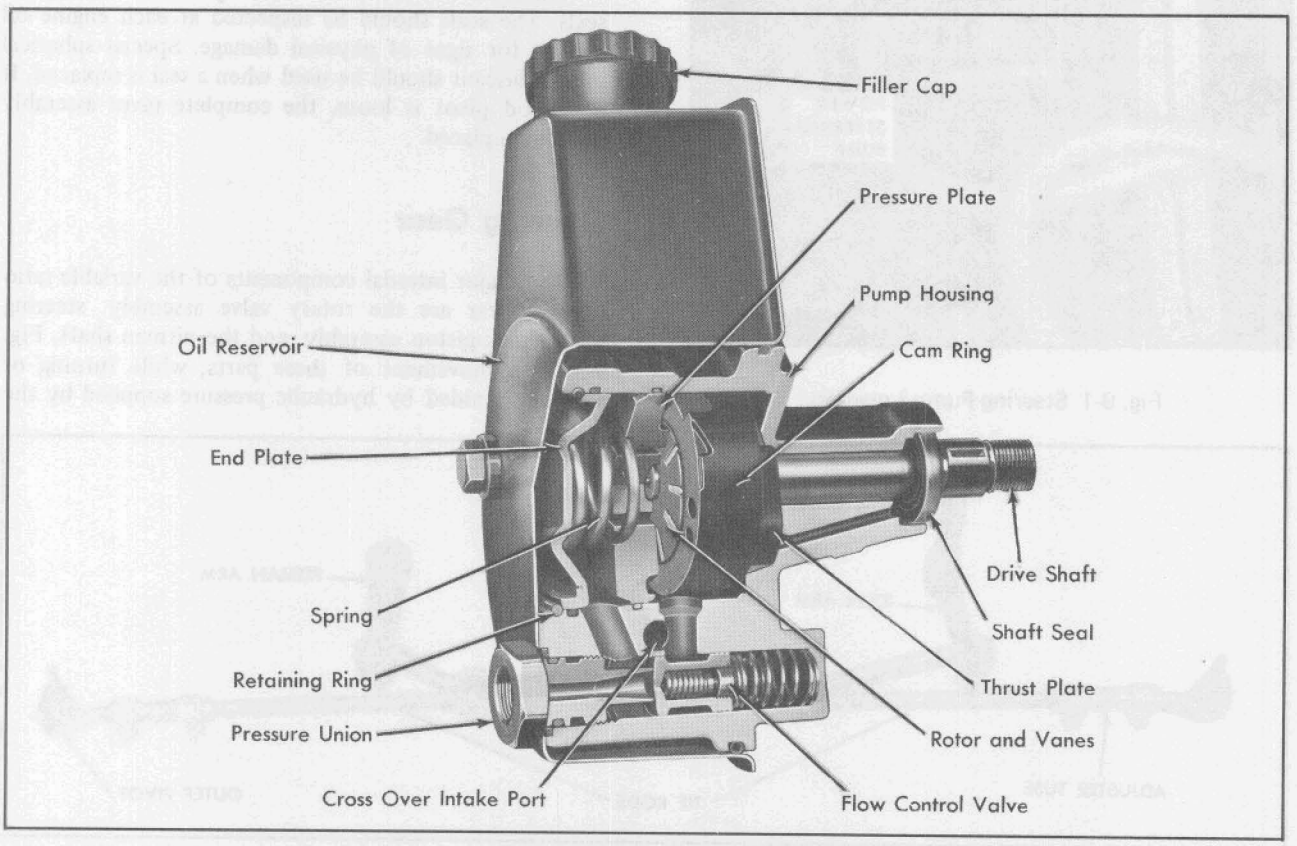


Fig. 9-4 Steering Pump Cutaway

pump. Manual steering is always available at times when the engine is not running, or in the event of pump failure. Steering effort is increased under such conditions.

The steering input shaft, hydraulic valve, worm shaft, and rack-piston assembly are all "in line". The rack-piston in the variable ratio steering gear is modified to accommodate the larger center tooth on the pitman shaft gear, Fig. 9-3. All oil passages are internal within the gear housing, except for the pressure and return tubes between the gear and the pump.

The mechanical element of this steering gear is a low-friction, recirculating ball system, in which steel balls act as a rolling thread between the steering worm and the rack-piston. The one-piece rack-piston assembly is geared to the sector of the pitman shaft.

The hydraulic rotary valve is concentric with the input shaft and is contained in the upper section of the gear housing. It contains a spool that is held in neutral position by means of a torsion bar. The spool is attached to one end of the torsion bar and the valve body to the other end. Twisting of the torsion bar allows the spool to rotate in relation to the valve body, thereby operating the valve.

Under normal driving conditions the steering wheel effort will range from 1 to 1-1/2 pounds, and parking effort will range from 2 to 2-1/2 pounds.

Steering Pump

The major components of the power steering pump are the oil reservoir, drive shaft, pump housing, cam ring, pressure plate, thrust plate, flow control valve, and rotor and vane assembly, Fig. 9-4. The pump housing and component parts are encased in the oil reservoir. The reservoir filler cap has a dipstick attached to show the oil level in the reservoir.

There are two bore openings at the rear of the pump housing. The larger of these openings contains the cam ring, pressure plate, thrust plate, rotor and vane assembly, and end plate. The smaller opening contains the pressure line union, flow control valve, and spring. The flow control orifice is part of the pressure line union. A pressure relief valve inside the flow control valve limits pump pressure to 1350-1450 psi.

Energy Absorbing Steering Column (Fig. 9-5)

The steering columns used on Cadillac automobiles are of the energy absorbing type. The outer jacket consists of two tubes of different diameters joined together by four rows of ball bearings (36 balls total) that are pressed into position. During impact, the ball bearings roll along the jacket wall allowing the smaller, lower end of the jacket to collapse within the larger upper end. The steering shaft is constructed in two parts fitting together so that they can telescope. The shift tube is constructed in two telescoping parts. An injected plastic joint holds the telescoping parts of both the steering shaft and the shift tube so that they remain in the proper relationship under normal operation.

The column is supported in the car at the upper mounting position by a bracket containing two release capsules. If an excessive impact load acts on the upper

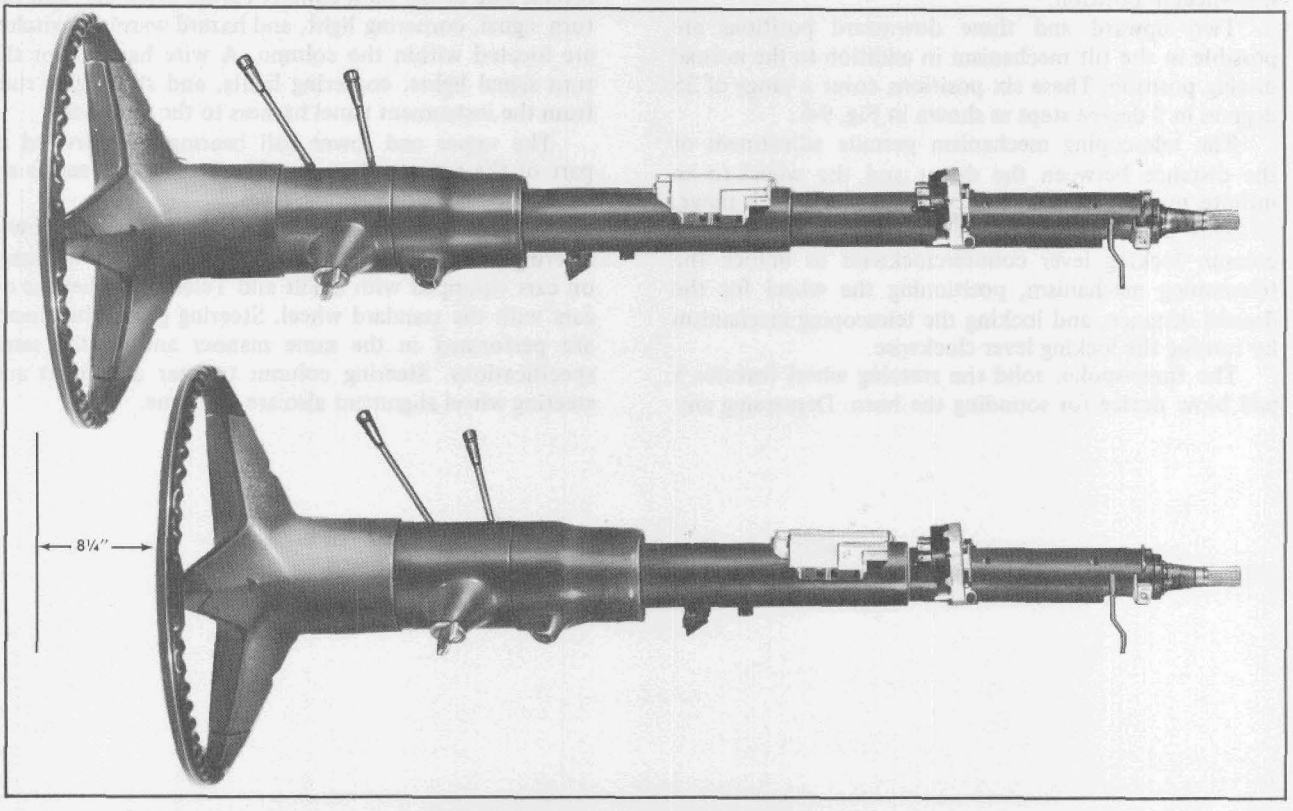


Fig. 9-5 Energy Absorbing Steering Column

end of the column, the upper mount release capsules will shear and allow the column to collapse downward.

CAUTION: Do not use bolts longer than specified at the upper mounting capsule bracket to jacket attachment.

Equally important is the correct torquing of all nuts and bolts. Follow exactly the torque recommendations given in every step. The column must be handled and serviced with extreme care. Use only the specified screws, bolts and nuts during reassembly.

At no time should the column, shift tube, or steering shaft be struck from either end with a hammer, or pulled excessively. Care must also be taken never to let the column drop when removing or installing to prevent accidental collapse of either the steering shaft or the outer jacket.

Tilt and Telescope Steering Column (Figs. 9-6 and 9-59)

The Tilt and Telescope steering column consists of a steering shaft with a spherical joint, adjusting and locking mechanism for tilt adjustment; a telescoping upper shaft and yoke assembly, and locking mechanism for telescopic adjustment. These adjustments are made independently of each other.

The up and down tilt action is achieved by pulling upward on a small lever located on the left side of the steering column just below the directional signal lever, which allows the steering wheel to be positioned at any one of six possible angles. Releasing the lever will lock the wheel in position.

Two upward and three downward positions are possible in the tilt mechanism in addition to the normal driving position. These six positions cover a range of 25 degrees in 5 degree steps as shown in Fig. 9-6.

The telescoping mechanism permits adjustment of the distance between the driver and the wheel to an infinite number of positions within a 2-1/8 inch range.

This adjustment is made by rotating the steering column locking lever counterclockwise to unlock the telescoping mechanism, positioning the wheel for the desired distance, and locking the telescoping mechanism by turning the locking lever clockwise.

The three-spoke, solid rim steering wheel features a pad blow device for sounding the horn. Depressing any

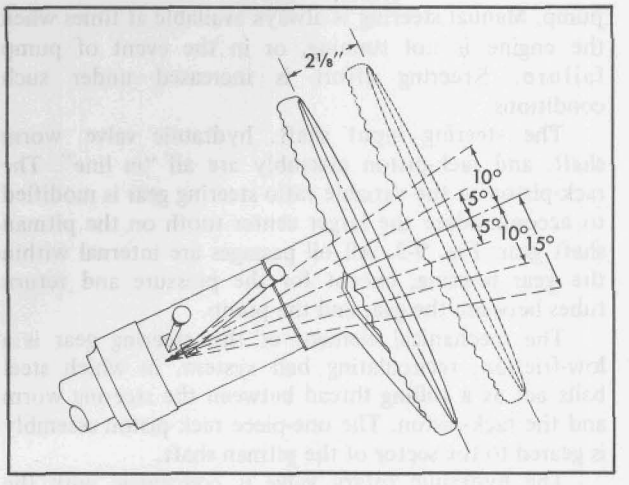


Fig. 9-6 Tilt and Telescope Steering Wheel

part of the "T" shaped horn pad will blow the horn.

The lead wire is connected to the spring support on the underside of the steering wheel. A coiled spring which expands and contracts when the wheel is telescoped connects the lead wire with the lower contact assembly.

The coiled spring rides upon a horn wire clip and spring assembly located in the turn signal housing. The horn wire is attached to the chassis wiring harness through a connector.

The horn hazard warning, and turn signal wiring are integral components of the turn signal housing assembly, and are serviced as an assembly.

The turn signal cancelling cams are located on the reverse side of the horn contact carrier assembly, and the turn signal, cornering light, and hazard warning switches are located within the column. A wire harness for the turn signal lights, cornering lights, and stop lights runs from the instrument panel harness to the switches.

The upper and lower ball bearings are serviced as part of the actuator housing. The bearing preload is set by the upper bearing spring.

Service operations on the steering gear, power steering pump, and steering linkage are exactly the same on cars equipped with a Tilt and Telescope wheel as on cars with the standard wheel. Steering gear adjustments are performed in the same manner and to the same specifications. Steering column to gear alignment and steering wheel alignment also are the same.

STEERING GEAR AND PUMP DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Hissing noise in steering gear.	There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and performance of the steering. "Hiss" may be expected when steering wheel is at end of travel or when slowly turning at standstill.	Slight "hiss" is normal and in no way affects steering. Do not replace valve unless "hiss" is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure for the objection. Investigate clearance around flexible coupling rivets. Be sure steering shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates. Any metal-to-metal contacts through flexible coupling will transmit valve "hiss" into passenger compartment through the steering column.
Rattle or chuckle noise in steering gear.	Gear loose on frame. Steering linkage looseness. Loose pitman shaft over center adjustment. (NOTE: A slight rattle may occur on turns because of increased clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.)	Check gear-to-frame mounting screws. Tighten screws to specified torque. Check linkage pivot points for wear. Replace if necessary. Adjust to specifications.
Squawk noise in steering gear when turning or recovering from a turn.	Dampener "O" ring on valve spool cut.	Replace dampener "O" ring.
Chirp noise in steering pump.	Loose belt.	Adjust belt tension to specification.
Belt squeal (Particularly noticeable at full wheel travel and stand still parking).	Loose belt.	Adjust belt tension to specification.
Growl noise in steering pump.	Excessive back pressure in hoses or steering gear caused by restriction.	Locate restriction and correct. Replace part if necessary.
Growl noise in steering pump (Particularly noticeable at standstill parking).	Scored pressure plates, thrust plate or rotor. Extreme wear of cam ring.	Replace parts, disassemble gear and clean. Flush hoses. Replace parts, disassemble gear and clean. Flush Hoses.
Groan noise in steering pump.	Low fluid level. Air in the fluid. Poor pressure hose connection.	Fill reservoir to proper level. Tighten connector to specified torque. Bleed system by operating steering from right to left -- full turn.
Rattle or Knock noise in steering pump.	Loose pump pulley nut.	Tighten nut to specified torque.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

CONDITION	CAUSE	CORRECTION
Rattle noise in steering pump.	Vanes not installed properly.	Install properly.
	Vanes sticking in rotor slots.	Free up by removing burrs, varnish or dirt.
Swish noise in steering pump.	Defective flow control valve.	Replace part.
Whine noise in steering pump.	Pump shaft bearing scored.	Replace housing and shaft. Disassemble gear and clean. Flush hoses.
Poor return of steering wheel to center.	Lack of lubrication in linkage and spherical joints.	Lube linkage and spherical joints. Check seals for damage and replace if necessary.
	Lower coupling flange rubbing against steering gear adjuster plug.	Loosen pinch bolt and assemble properly.
	Steering gear to column misalignment.	Align steering column.
	Tires not properly inflated.	Inflate to specified pressure.
	Improper front wheel alignment.	Check and adjust as necessary.
		With front wheels still on alignment pads of front-end machine, disconnect pitman arm of linkage from pitman shaft of gear. Turn front wheels by hand. If wheels will not turn or turn with considerable effort, determine if linkage or spherical joints are binding.
	Steering linkage binding.	Replace pivots.
	Spherical joints binding.	Replace spherical joints.
	(Turn steering wheel and listen for internal rubbing in column - check causes listed and correct as directed.)	
	Steering wheel rubbing against directional signal housing.	Adjust steering jacket.
	Tight or frozen steering shaft bearings.	Replace bearings.
	Rubber spacer binding in shift tube.	Make certain spacer is properly seated. Lubricate inside diameter with silicone.
	Sticky or plugged valve spool.	Remove and clean or replace valve.
	Steering gear adjustments tight.	Check adjustment with gear out of vehicle. Adjust as required.
Car leads to one side or the other.	Front end misaligned.	Adjust to specifications.
(Keep in mind road condition and wind. Test car on flat road going in both directions)	Unbalanced steering gear valve.	Replace valve.
	(NOTE: If this is cause, steering effort will be very light in direction of lead and heavy in opposite direction.)	

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

CONDITION	CAUSE	CORRECTION
Momentary increase in effort when turning wheel fast to right or left.	Low fluid level in pump. Pump belt slipping. High internal leakage.	Add power steering fluid as required. Tighten or replace belt. Check pump pressure. (See pump pressure test).
Steering wheel surges or jerks when turning with engine running especially during parking.	Low fluid level. Loose pump belt. Steering linkage hitting engine oil pan at full turn. Insufficient pump pressure. Sticky flow control valve.	Fill as required. Adjust tension to specification. Correct clearance. Check pump pressure. (See pump pressure test). Replace relief valve if defective. Inspect for varnish or damage, replace if necessary.
Excessive wheel kickback or loose steering.	Air in system. Steering gear loose on frame. Steering gear flexible coupling loose on shaft or rubber disc mounting screws loose. Steering linkage joints worn enough to be loose. Front wheel bearings incorrectly adjusted or worn. Worn poppet valve (Gear). Loose thrust bearing preload adjustment. (Gear) Excessive "over-center" lash.	Add power steering fluid to pump reservoir and bleed by operating steering. Check hose connectors for proper torque and adjust as required. Tighten attaching screws to specified torque. Tighten flange pinch bolts to specified torque, if serrations are not damaged. Tighten upper flange to coupling nuts to specified torque. Replace loose pivots. Adjust bearings or replace with new parts as necessary. Replace poppet valve. Adjust to specification with gear out of vehicle. Adjust to specification with gear out of vehicle.
Hard steering or lack of assist. (NOTE: If previous checks do not reveal cause of hard steering, follow the procedure below to determine fault.)	Loose pump belt. Low fluid level in reservoir. (NOTE: Low fluid level will also result in excessive pump noise.) Steering gear to column misalignment. Lower coupling flange rubbing against steering gear adjuster plug. Tires not properly inflated. Further possible causes could be: Sticky flow control valve. Insufficient pump pressure out put. Excessive internal pump leakage. Excessive internal gear leakage.	Adjust belt tension to specification. Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors to specified torque. Align steering column. Loosen pinch bolt and assemble properly. Inflate to recommended pressure. In order to diagnose conditions listed below, a test of the entire power steering system is required.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

CONDITION	CAUSE	CORRECTION
Foaming milky power steering fluid, low fluid level, and possible low pressure.	Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.	Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeriation should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.
Low pressure due to steering pump.	Flow control valve stuck or inoperative.	Remove burrs or dirt or replace.
	Pressure plate not flat against cam ring.	Correct.
	Extreme wear of cam ring.	Replace parts. Disassemble gear and clean. Flush hoses.
	Scored pressure plate, thrust plate or rotor.	Replace parts (If rotor, replace with rotating group kit), disassemble gear and clean.
	Vanes not installed properly.	Install properly.
	Vanes sticking in rotor slots.	Free-up by removing burrs, varnish or dirt.
	Cracked or broken thrust or pressure plate.	Replace part.
Low pressure due to steering gear.	Pressure loss in cylinder due to worn piston ring or scored housing bore.	Remove gear from car for disassembly and inspection of ring and housing bore.
	Leakage at valve rings, valve body to worm seal.	Remove gear from car for disassembly and replace seals.

STEERING LINKAGE DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Excessive play or looseness in steering system.	Front wheel bearings loosely adjusted.	Adjust bearings or replace with new parts as necessary.
	Worn couplings or steering shaft U-joints.	Replace.
	Worn upper spherical joints.	Replace.
	Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball studs.	Tighten to specified torque.
	Steering gear worm bearings loosely adjusted.	Adjust preload to specification.
	Excessive pitman shaft or ball nut lash in steering gear.	Adjust preload(s) to specification.
	Worn intermediate rod or tie rod sockets.	Replace worn parts.

STEERING LINKAGE DIAGNOSIS CHART (Cont'd.)

CONDITION	CAUSE	CORRECTION
Excessive looseness in tie rod or intermediate rod pivots, or excessive vertical lash in idler support.	Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear.	Replace damaged or worn parts as necessary.
Hard Steering--Excessive effort required at steering wheel.	Low or uneven tire pressure.	Inflate to specified pressures.
	Steering linkage or spherical joints need lubrication.	Lube with specified lubricant. Check for damaged seal.
	Tight or frozen intermediate rod, tie rod or idler socket.	Lube or replace as necessary. Check for damaged seal.
	Steering gear to column misalignment.	Align column.
	Steering gear adjusted too tightly.	Adjust preload to specification.
	Front wheel alignment incorrect.	Check alignment and correct as necessary.
Poor returnability.	Steering linkage or spherical joints need lubrication.	Lube with specified lubricant.
	Steering gear adjusted too tightly.	Adjust preload to specifications.
	Front wheel alignment incorrect.	Check alignment and correct as necessary.
	Steering gear to column misalignment.	Align column.

STANDARD COLUMN DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Will not unlock.	Sector collapsed.	Replace sector.
	Lock bolt damaged.	Replace lock bolt.
	Defective lock cylinder.	Replace lock cylinder.
	Damaged housing.	Replace housing.
Will not lock.	Lock bolt spring broken or defective.	Replace lock bolt spring.
	Damaged sector tooth.	Replace sector.
	Defective lock cylinder.	Replace lock cylinder.
	Burr on lock bolt or housing.	Remove burr.
	Damaged housing.	Replace housing.
	Transmission linkage adjustment incorrect.	Readjust.
	Sector installed incorrectly.	Install correctly.
High effort.	Lock cylinder defective.	Replace lock cylinder.
	Ignition switch defective.	Replace ignition switch.

STANDARD COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
High effort (Cont'd.)	Rack preload spring broken or deformed.	Replace rack preload spring.
	Burrs on sector, rack or housing.	Remove burr.
	Bent sector shaft.	Replace housing assembly.
	Actuator rod restricted.	Remove restriction.
High effort on lock cylinder between "off" and "off-lock".	Burr on tang of shift gate.	Remove burr.
	Distorted rack.	Replace rack.
Will stick in "start".	Actuator rod deformed.	Straighten or replace.
	Any high effort condition.	Check items under high effort section.
	Ignition switch defective.	Replace switch.
Lock bolt hits shaft lock in "off" position and "park".	Ignition switch is not set correctly.	Readjust ignition switch.
Key cannot be removed in "off-lock".	Ignition switch is not set correctly.	Readjust.
	Defective lock cylinder.	Replace lock cylinder.
Lock cylinder can be removed without depressing retainer.	Lock cylinder with defective retainer.	Replace lock cylinder.
	Lock cylinder without retainer.	Replace lock cylinder.
	Burr over retainer slot in housing.	Remove burr in housing.
	IGNITION SYSTEM	
Electrical system will not function.	Defective fuse in "accessory" circuit.	Replace fuse.
	Connector body loose or defective.	Tighten or replace.
	Defective wiring.	Repair or replace.
	Defective ignition switch.	Replace ignition switch.
Switch will not actuate mechanically.	Defective ignition switch.	Replace ignition switch.
Switch cannot be set correctly.	Switch actuator rod deformed.	Repair or replace switch actuator rod.
Noise in column.	Coupling bolts not tightened.	Tighten pinch bolts to specified torque.
		Tighten coupling bolts to specified torque. (Parts should be inspected for damage before reassembling. If serrations or threads are damaged, replace parts).
	Coupling pulled apart.	Realign column and replace coupling.

STANDARD COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Noise in Column (Cont'd.)		Broken shaft plastic injected joint. If shaft is damaged, replace -- if not, repair joint using steering shaft repair kit.
	Horn contact ring not lubricated.	Lubricate with lubriplate or equivalent.
	Lack of grease on bearings or bearing surface.	Lubricate.
	Lower shaft bearing tight or frozen.	Replace bearing. Check shaft and replace if scored.
	Upper shaft bearing tight or frozen.	Replace housing assembly.
	Shaft lock plate cover loose.	Tighten three screws to specified torque or, if missing, replace. *CAUTION: Use specified screws only.*
	Lock plate retaining ring not seated.	Replace retaining ring. Check for proper seating in groove.
	Shaft lock plate cover loose.	Tighten three screws.

Method to Determine Column Collapse

Measure distance between top of neutral-start switch window opening and the bottom of the upper jacket. The correct dimension is 5 11/16" - 5 1/2".

CONDITION	POSSIBLE CAUSE	CORRECTION
One click when in "off-lock" position and the steering wheel is moved.		None - normal -- lock bolt is seating.
High steering shaft turning effort.	Column assembly misaligned in vehicle.	Align correctly.
	Improperly installed or deformed dust seal.	Replace dust seal.
	Tight or frozen upper or lower bearings.	Replace.
	"E" car only.	Replace U-Joint
	U-Joint binding.	
High shift effort.	Column not aligned correctly in car.	Realign
	Lower bowl bearing not assembled correctly.	Reassemble correctly.
	Improperly installed dust seal.	Remove and replace.
	Lack of grease on seal or bearing areas.	Lubricate.

STANDARD COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Improper transmission shifting.	Sheared shift tube joint.	Replace shift tube assembly.
	Improper transmission linkage adjustment.	Readjust.
	Improper gate plate.	Replace with correct part.
Miscellaneous.	Shroud loose on shift bowl.	Bend tabs on shroud over lugs on bowl.
	Housing loose on jacket -- will be noticed with ignition in "off-lock" and a torque applied to the steering wheel.	Tighten four mounting screws to specified torque.
Lash in mounted column assembly.	IP to dash mounting bolts loose.	Tighten to specified torque.
	Broken weld nuts on jacket.	Replace jacket assembly.
	IP bracket capsule sheared.	Replace bracket assembly.
	IP to jacket mounting bolts loose.	Tighten to specified torque.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Will not unlock.	Shear flange on sector shaft collapsed.	Replace sector.
	Lock bolt damaged.	Replace lock bolt.
	Defective lock cylinder.	Replace lock cylinder.
	Damaged housing.	Replace housing.
	Damaged sector.	Replace sector.
	Damaged rack.	Replace rack.
Will not lock.	Lock bolt spring broken or defective.	Replace lock bolt spring.
	Damaged sector tooth.	Replace sector.
	Defective lock cylinder.	Replace lock cylinder.
	Burr on lock bolt or housing.	Remove burr.
	Damaged housing.	Replace housing.
	Transmission linkage adjustment incorrect.	Readjust.
	Damaged rack.	Replace rack.
	Interference between bowl and rack coupling.	Replace bowl or actuator rod as required.
	Ignition switch stuck.	Replace ignition switch.
	Actuator rod restricted.	Readjust.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
High effort.	Lock cylinder defective.	Replace lock cylinder.
	Ignition switch defective.	Replace ignition switch.
	Rack preload spring broken or deformed.	Replace preload spring.
	Burrs on sector, rack, housing, support or actuator rod coupling.	Remove burr.
	Bent sector shaft.	Replace shaft.
	Defective rack.	Replace rack.
	Extreme misalignment of housing to cover.	Replace either or both.
	Distorted coupling slot in rack.	Replace rack.
	Bent actuator rod.	Straighten or replace.
	Ignition switch mounting bracket bent.	Straighten or replace.
Will stick in "start".	Actuator rod deformed.	Straighten or replace.
	Any high effort condition.	Check items under high effort section.
	Ignition switch defective.	Replace switch.
Key cannot be removed in "off-lock".	Ignition switch is not adjusted correctly.	Readjust
	Defective lock cylinder.	Replace lock cylinder.
Lock cylinder can be removed without depressing retainer.	Lock cylinder with defective retainer.	Replace lock cylinder.
	Lock cylinder without retainer.	Replace lock cylinder.
	Burr over retainer slot in housing cover.	Remove burr.
	IGNITION SYSTEM	
Electrical system will not function.	Poor battery connection.	Connect securely.
	Defective fuse.	Replace fuse.
	Connector body loose or defective.	Tighten or replace.
	Defective wiring.	Repair or replace.
	Defective ignition switch.	Replace ignition switch.
	Ignition switch not adjusted properly.	Readjust.
Switch will not actuate mechanically.	Defective ignition switch.	Replace.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Switch cannot be set correctly.	Switch actuator rod deformed.	Repair or replace.
	Sector to rack engaged in wrong tooth.	Engage correctly.
	COLUMN	
Noise in column.	Coupling bolts not tightened.	Tighten pinch bolts to specified torque.
	Column not correctly aligned.	Realign column.
	Coupling pulled apart.	Realign column and replace coupling.
	Broken steering shaft plastic injected joint.	Repair joint using steering shaft repair kit and realign column.
	Horn contact ring not lubricated.	Lubricate with lubriplate or equivalent.
	Lack of grease on bearings or bearing surfaces.	Lubricate
	Loose tilt lever opening shields.	Bend to eliminate rattle.
	Lower shaft bearing worn or broken.	Replace bearing.
		Check shaft and replace if scored.
	Upper shaft bearing worn or broken.	Replace bearing assembly.
	One click when in "off-lock" position and the steering wheel is moved.	Normal -- lock bolt is seating.
High steering shaft effort.	Column assembly misaligned.	Realign.
	Improperly installed or deformed dust seal.	Install new seal.
	Defective upper or lower bearing.	Replace.
	Flashing on I.D. of shift tube from plastic joint.	Replace shift tube.
	Tight steering universal joint. "E" car only.	Repair or replace.
High shift effort.	Column not aligned correctly in car.	Realign.
	Wave washer with burrs.	Replace.
	Improperly installed dust seal.	Remove and replace.
	Lack of grease on seal or bearing.	Lubricate.
	Improper screws used for ignition switch, neutral start switch or mounting bracket.	Use correct fasteners.
	Burr on upper or lower end of shift tube.	Remove burr.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Improper transmission shifting.	Sheared shift tube joint. Improper transmission linkage adjustment.	Replace tube assembly. Readjust.
Miscellaneous.	Housing loose on jacket -- will be noticed with ignition in "off-lock" and a torque applied to the steering wheel.	Tighten four mounting screws to specified torque.
Lash in mounted column assembly.	IP to dash mounting bolts loose. Broken weld nuts on jacket. IP bracket capsule sheared. Loose shoes in housing. Loose tilt head pivot pins. Loose shoe lock pin in support. Loose support screws.	Tighten to specified torque. Replace jacket assembly. Replace bracket assembly. Replace shoes. Replace pivot pins. Replace pin. Tighten to specified torque.
Housing scraping on bowl.	Bowl bent or not concentric with hub.	Replace bowl.
Steering wheel loose.	Wheel loose on shaft. Defective or missing anti-lash spring in spheres. Upper bearing not seating in bearing race. Upper bearing inner race seat missing. Improperly adjust T & T locking lever. Loose support screws. Bearing preload spring missing or broken.	Tighten nut to specified torque. Add spring or replace both. Replace both. Install seat. Readjust. Tighten to specified torque. Replace preload spring.
Steering wheel loose -- every other tilt position.	Loose fit between shoe and shoe pivot pin.	Replace both.
Steering column not locking in any tilt position.	Shoe seized on its pivot pin. Shoe grooves may have burrs or dirt. Shoe lock spring weak or broken.	Replace both. Replace shoe. Replace lock spring.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Steering wheel fails to return to top tilt position.	Pivot pins are bound up. Wheel tilt spring is defective. Turn signal switch wires too tight.	Replace pivot pins. Replace tilt spring. Readjust.
Noise when tilting column.	Upper tilt bumpers worn. Tilt spring rubbing in housing.	Replace tilt bumper. Lubricate.

Method to Determine Column Collapse

Measure distance between top of neutral-start switch window opening and the bottom of the upper jacket. The correct dimension is 5 11/16" - 5 1/2".

TURN SIGNAL SWITCH DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Turn signal will not cancel.	Loose switch mounting screws. Switch or anchor bosses broken. Broken, missing or out of position detent, return or cancelling spring. Uneven or incorrect cancelling cam to cancelling spring interference. (.120)/side.	Tighten to specified torque. Replace switch. Reposition or replace spring as required. Adjust switch position: If interference is correct and switch will still not cancel, replace switch. If interference cannot be corrected by switch adjustment, replace cancelling cam.
Turn signal difficult to operate.	Actuator rod loose. Yoke broken or distorted. Loose or misplaced springs. Foreign parts and/or material. Switch mounted loosely.	Tighten to specified torque. Replace switch. Reposition or replace springs. Remove foreign parts and/or material. Tighten mounting screws to specified torque.
Turn signal will not indicate lane change.	Broken lane change pressure pad or spring hanger. Broken, missing or misplaced lane change spring. Jammed base or wires.	Replace switch. Replace or reposition as required. Loosen mounting screws, reposition base or wires and retighten screws to specified torque.

TURN SIGNAL SWITCH DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Turn signal will not stay in turn position.	Foreign material or loose parts impeding movement of yoke.	Remove material and/or parts.
	Broken or missing detent or cancelling spring.	Replace spring.
	None of the above.	Replace switch.
Hazard switch cannot be turned off.	Foreign material between hazard support cancelling leg and yoke.	Remove foreign material.
		No foreign material impeding function of hazard switch -- replace turn signal switch.
Hazard switch will not stay on or difficult to turn off.	Loose switch mounting screws.	Tighten mounting screws to specified torque.
	Interference with other components.	Remove interference.
	Foreign material.	Remove foreign material.
	None of the above.	Replace switch.
	Actuating lever not installed properly.	Reinstall switch and lever assembly.
No turn signal lights.	Defective or blown fuse.	Replace fuse.
	Inoperative turn signal flasher.	Replace turn signal flasher. (Note: There are two flashers in the system. Consult manual for location.)
	Loose chassis to column connector.	Connect securely.
	Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand.	
	If vehicle lights now operate normally, signal switch is inoperative.	Replace signal switch.
	If vehicle lights do not operate, check chassis wiring for opens, grounds, etc.	Repair chassis wiring as required using manual as guide.
Turn indicator lights on, but not flashing.	Inoperative turn flasher.	Replace turn flasher.
	Loose chassis to column connection.	Connect securely.
	Inoperative turn signal switch.	Replace turn signal switch.
	To determine if turn signal switch is defective, substitute new switch into circuit and operate switch by hand.	
	If the vehicle's lights operate normally, signal switch is inoperative.	Replace signal switch.
	If the vehicle's lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc.	Repair chassis wiring as required using manual as guide.

TURN SIGNAL SWITCH DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Front or rear turn signal lights not flashing.	Burned out or damaged turn signal bulb.	Replace bulb.
	High resistance connection to ground at bulb socket.	Remove or repair defective connection.
	Loose chassis to column connector.	Connect securely.
	Disconnect column to chassis connector. Connect new switch into system and operate switch by hand.	
	If turn signal lights are now on and flash, turn signal switch is inoperative.	Replace turn signal switch.
	If vehicle lights do not operate, check chassis wiring harness to light sockets for opens, grounds, etc.	Repair chassis wiring as required using manual as guide.
Stop light not on when turn indicated.	Loose column to chassis connection.	Connect securely.
	Disconnect column to chassis connector.	
	Connect new switch into system without removing old.	
	Operate switch by hand.	
	If brake lights work with switch in the turn position, signal switch is defective.	Replace signal switch.
	If brake lights do not work, check connector to stop light, sockets, for grounds, open, etc.	Repair connector to stop light circuits using manual as guide.
Turn indicator panel lights not flashing.	Burned out bulbs.	Replace bulbs.
	High resistance to ground at bulb socket.	Replace socket.
	Opens, grounds in wiring harness from front turn signal bulb socket to indicator lights.	Locate and repair as required. Use shop manual as guide.
Turn signal lights flash very slowly.	Inoperative turn signal flasher.	Replace turn signal flasher.
	System charging voltage low.	Increase voltage to specified. Use manual.
	High resistance ground at light sockets.	Repair high resistance grounds at light sockets.
	Loose chassis to column connection.	Connect securely.
	Disconnect column to chassis connector. Connect new switch into system without removing old.	
	Operate switch by hand. If flashing occurs at normal rate, the signal switch is defective.	Replace signal switch.

TURN SIGNAL SWITCH DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Turn signal lights flash very slowly. (Cont'd.)	If the flashing rate is still extremely slow, check chassis wiring harness from the connector to light sockets for grounds, high resistance points, etc.	Locate and repair as required. Use manual as guide.
Hazard signal lights will not flash -- turn signal functions normally.	Blown fuse.	Replace fuse.
	Inoperative hazard warning flasher.	Replace hazard warning flasher.
	Loose chassis to column connection.	Connect securely.
	Disconnect column to chassis connector. Connect new switch into system without removing old.	
	Depress the hazard warning button and observe the hazard warning lights. If they now work normally, the turn signal switch is defective.	Replace the turn signal switch.
	If the lights do not flash, check wiring harness for open between hazard flasher and harmonica connector. If open, fuse block is defective.	Replace fuse block.

KEY BUZZER DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer does not sound with key fully inserted in lock cylinder with the driver's door open.	Power not available to horn relay.	Check by operating horn. If it does not sound, restore power using manual as guide.
	Buzzer wire not connected at horn relay.	Connect.
	Horn relay inoperative.	Check by grounding #4 terminal on horn relay, if buzzer does not sound, replace horn relay.
	Door jamb switch on driver's side misadjusted or inoperative.	Readjust or replace -- as required.
	Short in chassis wiring.	Check by separating chassis to column connector. Connect (black) and (black w/pink stripe) female contacts on the chassis side. Bent paper clip will work if buzzer sounds, continue diagnosis. If not, locate and repair chassis wiring.

(Note 1: If the buzzer fault has not yet been detected, connect a continuity meter (light) to the male #E & #F connector contacts of the turn signal switch connector (Fig. 9-51). Insert the key the full depth into the lock cylinder.)

If contact is made with the key in, and is not made with it out, the function is normal. Retrace initial diagnostic steps.

If contact is not established, the fault is in the column. Proceed to Note 2.

KEY BUZZER DIAGNOSIS CHART (Cont'd.)

(Note 2: With the fault isolated in the column, disassemble the upper end of the column until the signal switch mounting screws have been removed. Lift the switch and check the probes of the buzzer switch to insure good contact with the pads on the signal switch. Bend probes, if required, then reseat the signal switch and install the three screws. Check the function, as in Note 1.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer does not sound, cont'd.	Short or fault in signal switch wiring.	Check wiring by connecting continuity meter on "E" terminal of connector and turn signal switch, buzzer switch pad with black wire attached and "F" terminal to pad with pink wire attached. If contact is made, function is normal. If not, replace signal switch.

(Note 3: If the buzzer has not yet been isolated and repaired, connect a continuity meter to the buzzer switch electrical contact probes. Fully insert and remove the key from the lock cylinder.)

If contact is made with the key in, and is broken with it out, the function is normal. Retrace diagnostic steps starting at Note 2.

If contact is not made, the fault is in the lock cylinder or buzzer switch.

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer does not sound cont'd.	Chips, burrs, foreign material preventing actuator tip function. *CAUTION: Key must be removed or cylinder in "run" position before removing lock cylinder.*	Remove chips, burrs, etc. Reassemble and re-check ref. note 3.
	Defective lock cylinder.	With the lock cylinder out (observing caution above), fully insert and remove the key. The actuator should extend and retract smoothly.
	Chips, foreign material affecting buzzer switch operation.	Remove and clean as required -- reassemble and re-check per note 3.
	Damaged or broken buzzer switch.	Replace buzzer switch.
	Switch appears good but will not make contact.	Connect continuity meter leads to the buzzer switch probes, Fig. 9-53. Press on the actuator pad until the interior points contact. If contact is not made, replace buzzer switch.
	Buzzer switch contact gap too large.	Reset contact gap.

(Note 4: Setting the contact gap, (Fig. 9-53). Press a .030 wire type spark plug gap wire with flat piece of stock on the actuator pad.)

If contact is not made adjust switch as shown until positive contact is made. (Use continuity meter).

With positive contact at .030, use a .025 plug gap wire beneath the flat stock. No contact should occur. Adjust as shown in (Fig. 9-53). When the switch will make contact with the .030 wire, and not with the .025, the buzzer switch is set at the low limit.

KEY BUZZER DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer continues to operate with key in the lock cylinder with the driver's door either opened or closed and ceases when key is removed.	Door jamb switch on driver's side misadjusted or inoperative.	Adjust or replace as required.
	Wire from signal switch to door jamb switch shorted.	If on signal switch side, replace signal switch.
		If on chassis side, find and repair-use manual.

(Note 5: This condition indicates the lock cylinder or buzzer switch is at fault. To verify, check for continuity at the "E" & "F" male connector contacts with the key removed from the lock cylinder, (Fig. 9-51). If continuity exists, the fault is in the column.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer continues to operate with key out, but stops when driver's door is closed.	Chips, foreign material in lock cylinder bore.	Remove, reassemble and recheck function.
	Sticky lock cylinder actuator tip.	Replace lock cylinder.
	Damaged or broken buzzer-switch.	Replace buzzer switch.
	Buzzer switch contact gap too close.	Adjust as specified.

SERVICE INFORMATION

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology *"See CAUTION on page 9-21."*

CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

Six factors affect power operation of the steering system: fluid level and condition, drive belt tension, loose pump pulley, loose component mountings, pump pressure, and steering gear adjustment. These should always be checked before any major service operations are performed.

Conditions such as hard or loose steering, road shock, or vibrations are not always due to steering gear or pump, but are often related instead to such factors as low tire pressure or front end alignment. These factors should be checked and corrected before any adjustment of the steering gear is made.

1. Checking Fluid Level

(NOTE: When making a complete fluid change, always use special power steering fluid available from servicing parts warehouses. When topping off the fluid, if the special fluid is not available, Dexron ® Automatic Transmission Fluid or equivalent may be used.

1. Run engine and turn gear from lock to lock three or four times, then shut engine off with gear in left turn position. Remove reservoir filler cap and check oil level on dipstick. Level should be halfway between "hot" and "cold" marks when fluid is approximately 150 degrees (reservoir is hot to touch).

2. If oil level when hot (approximately 150°) is below "cold" mark add special power steering fluid until level is halfway between the "hot" and "cold" marks on dipstick and reinstall filler cap.

(NOTE: At room temperature (approximately 70°) or before starting the engine, the fluid level should be between the "cold" and "add" marks on the dipstick. After high speed driving under high ambient conditions,

fluid will be at the "hot" mark at approximately 250° fluid temperature.)

3. When checking fluid level after making a complete fluid change, air must be bled from the system. Proceed as follows:

a. Install fluid in system. Fluid level in the pump must be at base of reservoir neck.

b. Raise front of car and with engine off, turn wheels all the way to the left.

c. Add power steering fluid to "Add" mark on dipstick.

d. Crank engine for one second or less without starting engine.

e. Add fluid if necessary to "Add" mark on dipstick.

f. Start engine and recheck fluid level. Add fluid if necessary to "Add" mark on dipstick.

g. Bleed system by turning wheels from side to side without hitting stops. Maintain fluid level just above internal pump casting. Fluid with air in it will have a light tan appearance. This air must be eliminated from fluid before normal steering action can be obtained.

h. Return wheels to center position and continue to run engine for two or three minutes, then shut engine off.

i. Road test car to make sure steering functions normally and is free from noise.

j. Recheck fluid level as described in step 1 making sure fluid is at the specified level.

2. Checking Pump Pressure

1. Disconnect pressure hose at union of pump, use a small container to catch any fluid which might leak.

2. Connect a spare pressure hose to pump union. A 1969 or 1970 hose may be more convenient than current production.

3. Using pressure gage, J-5176-1, adapter fitting, J-22326, connect gage to both hoses.

4. Open hand valve on gage.

5. Start engine, allow system to reach operating temperatures and check fluid level adding any fluid if required. When engine is at normal operating temperature, the initial pressure read on the gage (valve open) should be in the 80-125 PSI range. Should this pressure be in excess of 200 PSI, check the hoses for restrictions and the poppet valve for proper assembly.

6. Close gate valve fully three times. Record the highest pressures attained each time.

CAUTION: Do not leave valve fully closed for more than five seconds as the pump could be damaged internally.

7. If the pressures recorded are between 1350 - 1450 PSI and the range of readings are within 30 PSI, the pump is functioning within specifications.

8. If the pressures recorded are high, but do not repeat within 30 psi, the flow controlling valve is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and the gear must be completely disassembled, cleaned and reassembled before further usage.

9. If the pressures recorded are constant, but below the low listed specification, replace the flow control valve and recheck. If the pressures are still low, replace the rotating group.

10. If the pump checks to specification, leave the valve open and turn (or have turned) the steering wheel into both corners. Record the highest pressures and compare with the maximum pump pressure recorded. If this pressure cannot be built in either (or one) side of the gear, and is below specification, the gear is leaking internally and must be disassembled and repaired.

11. Shut off engine, remove testing gage, spare hose, reconnect pressure hose, check fluid level or make needed repairs. Run engine and recheck fluid level as outlined in Note 1.

3. Steering Pump Fluid Cooler Tube A/C Cars Only (Fig. 9-7)

a. Removal

1. Position container under fluid cooler to catch lubricant that will escape when hose and clamp are removed.

2. Remove clamp securing return hose to fluid cooler tube and position hose to prevent further leakage of fluid.

3. Separate return line from gear and plug opening at gear to prevent loss of fluid and entrance of dirt into system.

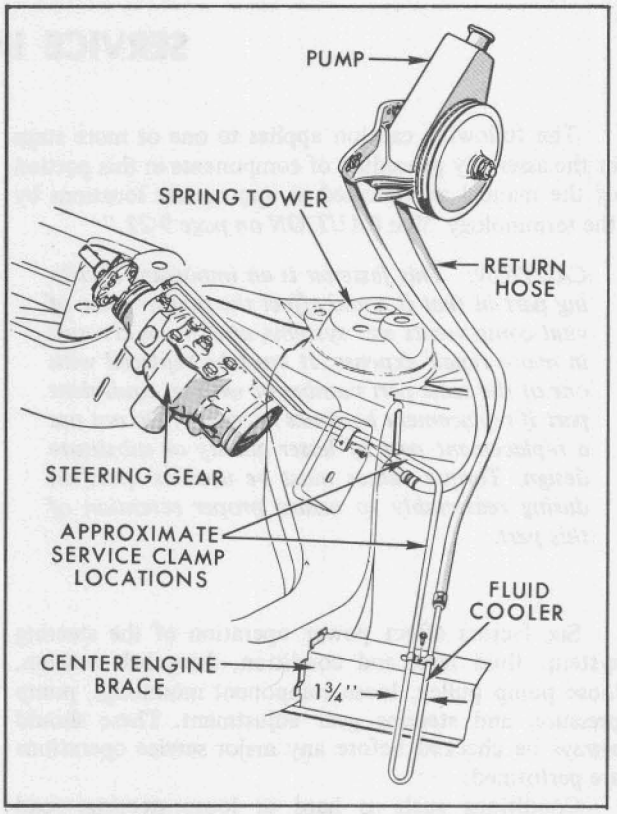


Fig. 9-7 Steering Pump Fluid Cooler Location A/C Only

4. Remove screws and clips securing cooler tube to frame center engine brace and underside of frame cross member.

(NOTE: Eldorado cooler is not secured at frame crossmember.)

5. Bend or cut cooler tube as necessary to facilitate removal from car, and remove cooler tube.

b. Installation

1. Obtain a fluid cooler repair kit consisting of a 1970 limousine cooler tube "trombone," two clamps approximately eight inches of power steering hose, and a shaped return line. (The return line is used on 1971 cars without air conditioning.)

(NOTE: If working on Eldorado, repair kit will not be necessary as cooler can be installed in one piece. Tighten return line fitting at gear to 30 foot-pounds, clip at engine center brace to 11 foot-pounds, and clamp securing cooler to pump return hose to 20 inch-pounds. Bleed and refill steering system, Note 1.)

2. Position "trombone" on center engine brace so that longest side is toward front of car and secure with clip and screw, tightening to 11 foot-pounds.

(NOTE: Make sure bend in tube is clear of right strut rod support member.)

3. Install 1971 non-A/C return tube in return line fitting of steering gear so that line is routed over gear and under frame.

4. Secure return line to underside of frame side-member with clamp and screw, tightening to 11 foot-pounds.

5. Install hose on return line and on longest end of "trombone" and secure each end with clamp, tightening to 20 inch-pounds.

6. Connect steering pump return hose to short end of "trombone" with clamp, tightening to 20 inch-pounds.

7. Bleed and refill steering system with power steering fluid, following procedure of Note 1.

4. Checking Steering Gear Adjustments (On Car)

Before making adjustments to the power steering gear to correct conditions such as shimmy, hard or loose steering, road shock, wander, or weave, a check should be made of front end alignment, shock absorbers, wheel balance, tire pressure or for tight front wheel bearings, loose steering rod ends, or loose pitman arm.

When steering gear is thought to be out of adjustment, a quick check can be made by moving steering wheel back and forth with short slow motions at the "on center" position with engine off. Excessive looseness felt or heard indicates that either the pitman shaft or the thrust bearing requires adjustment. These adjustments can be made on car with engine off as follows:

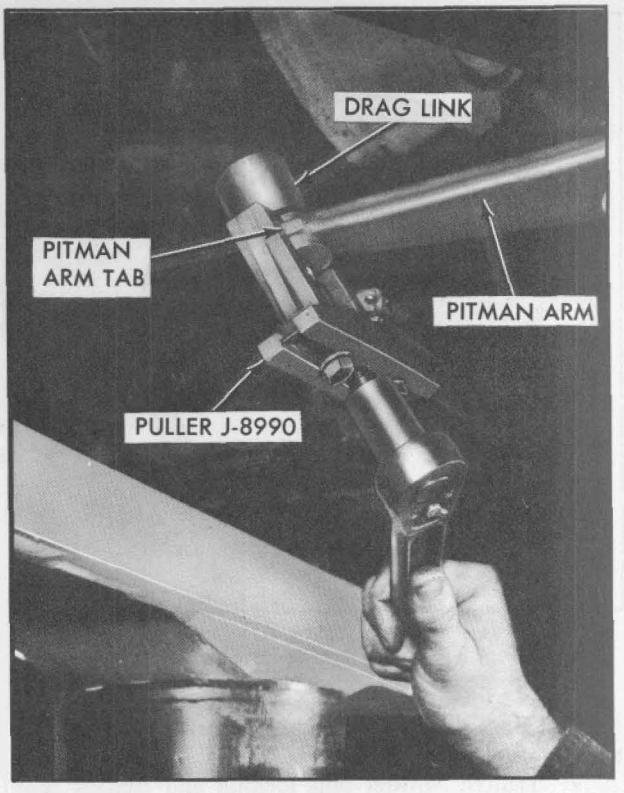


Fig. 9-8 Disconnecting Pitman Arm

a. Thrust Bearing Preload Check (Just Away From the Stops)

1. Remove pitman arm from drag link, using Puller Tool J-8990-01, Fig. 9-8. Make certain tool is positioned with puller engaging tabs on pitman arm. On 693, disconnect pitman arm from drag link as described in Note 27, steps 2, 3 and 4.

2. Check for any distortion or binding in flexible coupling. Correct as necessary, see Note 6.

3. Turn steering wheel just away from stops, and use a spring tension scale with a piece of string to measure pull on steering wheel through an arc not exceeding one inch, Fig. 9-9. Total pull should be between 4 and 12 ounces (thrust bearing and friction).

CAUTION: Make certain string and spring tension scale remain on a line tangent to the steering wheel as the reading is made; otherwise, inaccurate readings may result.

4. If pull is greater or less than specified, loosen adjuster plug locknut and back off adjuster plug 1/8 turn, using Spanner Wrench J-7624.

(NOTE: If position of holes in adjuster plug is such that there is insufficient clearance for using Spanner Wrench, insert a #10 bolt 3/4 inch long in one of the adjuster plug holes and rotate flexible coupling until lower flange contacts bolt. Then back off adjuster plug 1/8 turn.)

5. Recheck steering "pull" with wheel just away from the stops.

6. Adjust preload by tightening adjuster plug to obtain 2 to 6 ounces (at rim of steering wheel) in excess

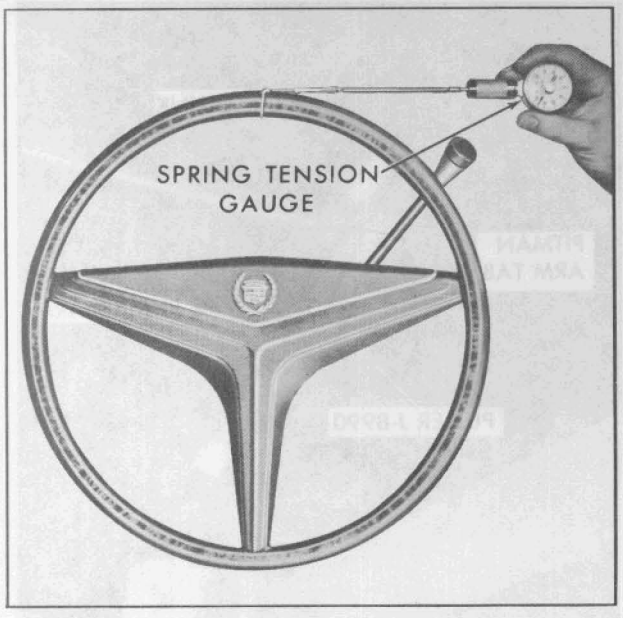


Fig. 9-9 Checking Steering Wheel Pull

of total drag that was just measured with adjuster plug backed-off 1/8 turn.

7. Tighten adjuster plug locknut and recheck preload to insure that plug did not move when nut was tightened.

b. Checking Worm and Ball Preload (1/2 Turn Off-Center)

1. Locate center of steering wheel travel and turn wheel 1/2 turn "off-center".

2. With wheel 1/2 turn "off-center", measure and record total pull through an arc not exceeding one inch. Due to worm and ball preload, the total pull should be from 2 to 8 ounces in excess of the pull just away from the stop previously recorded.

CAUTION: Make certain that string and spring tension scale remain on a line tangent to the steering wheel as the reading is made; otherwise inaccurate readings may result.

3. If total pull is less than one ounce or more than 9 ounces in excess pull, with wheel just away from stop, steering gear must be removed from car and disassembled for replacement of worm shaft balls, see Note 12e.

4. Check for roughness in worm and rack-piston by turning wheel between 1/4 turn and 1 turn "on-center" on each side. Noticeable roughness also requires worm replacement.

c. Checking Pitman Shaft End Play (On-Center)

1. Find exact center of steering wheel travel. Tight spot due to pitman shaft may extend for 1/4 turn on either side.

2. With wheel "on-center", measure and record total pull through an arc of three inches or less.

CAUTION: Make certain that string and spring tension scale remain on a line tangent to the steering wheel as the reading is made; otherwise, inaccurate readings may result.

3. This reading should not be more than 36 ounces, but should be 8 to 20 ounces more than a reading taken 1/2 turn "off-center".

(NOTE: On new steering gears, the factory setting with ball bearing preloads and new seal drag may cause total pull to be as high as 40 ounces. Within the first 100 miles of operation, the seals seat themselves and the ball bearings polish the rack-piston and worm shaft grooves sufficiently to meet the service specifications.)

4. If pitman shaft end play is not within limits, it should be adjusted so that "on-center" preload is 16-18 ounces more than the 1/2 turn "off-center" load but still not more than 36 ounces. Adjust on car by loosening locknut and turning adjusting screw as required. Recheck pull after tightening locknut.

5. When steering gear adjustments are completed, remove spring scale, connect pitman arm to drag link, and tighten drag link nut to 45 foot-pounds. Install cotter pin securing drag link nut. On 693, connect pitman arm to drag link as described in Note 27d. *See CAUTION on page 9-21.*

5. Steering Linkage Parallelism (Except 693)

The parallelism of the steering linkage drag link should be checked in cases of steering wander and instability after the normal corrective adjustments such as standing height and front wheel alignment have been made. A quick check can be made by sighting from the front of the car with the car on a wheel alignment machine.

The drag link should appear parallel with the bottom of the engine oil pan and frame front crossmember, Fig. 9-10. If it is not, correction can be made by loosening the idler arm support bracket mounting screws on the frame side rail and adjusting the bracket to obtain the desired drag link position. Tighten the mounting screws after adjustment. *See CAUTION on page 9-21.*

If the correction required cannot be made by this adjustment, additional correction can sometimes be obtained by tightening the pitman arm nut to a higher torque. This will move the pitman arm further onto the steering gear splined shaft.

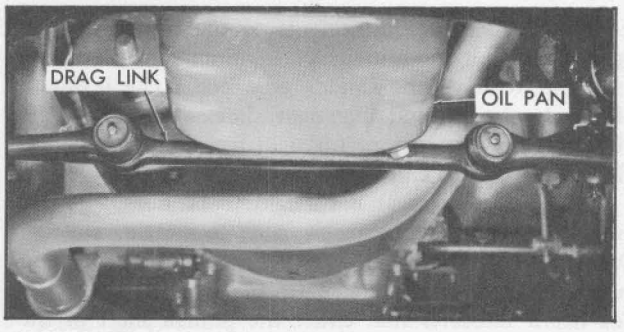


Fig. 9-10 Steering Linkage Parallelism

In no case should the pitman arm or idler arm be bent to obtain the required adjustment. *See CAUTION on page 9-21.*

6. Steering Column Alignment

(NOTE: Do not raise car on hoist while aligning column as full weight of car must be on wheels for proper alignment.)

1. Start engine and position front wheels in the straight ahead position for easy access to flex-coupling adjustment screws.

2. Remove steering column lower cover as described in Section 12, Note 41.

3. Loosen screw that attaches shift pointer to right hand side of column shift bowl to avoid damage to shift pointer while adjusting column.

4. Loosen two bolts that secure upper steering column mounting bracket to upper steering column support.

5. Loosen six screws that secure lower steering column bracket to toe pan and one clamp screw securing lower steering column bracket to column.

6. On "C" cars, loosen one clamp screw that secures steering shaft to flex-coupling clamp. On "693", loosen clamp screw securing steering extension shaft to universal joint clamp.

7. Align the steering colum to the instrument panel as follows:

a. Adjust in and out position of column to instrument panel as described below:

Upper edge of column shift bowl (at column centerline) must be the proper distance from instrument panel bezel to have correct steering wheel to driver relationship. If working on standard column, this distance should be 4-7/16", on Tilt and Telescope column, measurement should be 2-1/4".

b. After making the above adjustment, center column within the instrument panel bezel.

Lightly torque two upper mounting brackets to support bolts.

8. Check alignment of flex-coupling disc. The steering column and gear are correctly aligned when the rubber disc is flat and the pins are centered in the "C" slots in the upper flange. The pins should extend beyond the edges of the flange slots equally at both locations, Fig. 9-11. After alignment, tighten clamp screw to 30 foot-pounds. *See CAUTION on page 9-21.*

9. Install steering column lower support and make final adjustments as follows:

a. Position lower half of mounting bracket against column and lightly torque two bottommost bracket to toe pan screws.

b. Position upper half of mounting bracket and lightly torque remaining four bracket to toe pan screws.

c. Tighten clamp bolt securing bracket halves to 18 inch-pounds.

d. Start engine and turn steering wheel from stop to stop several times to neutralize position of column.

e. Tighten two upper mounting bracket to support bolts to 20-foot-pounds.

CAUTION: DO NOT exceed 20 foot-pounds as

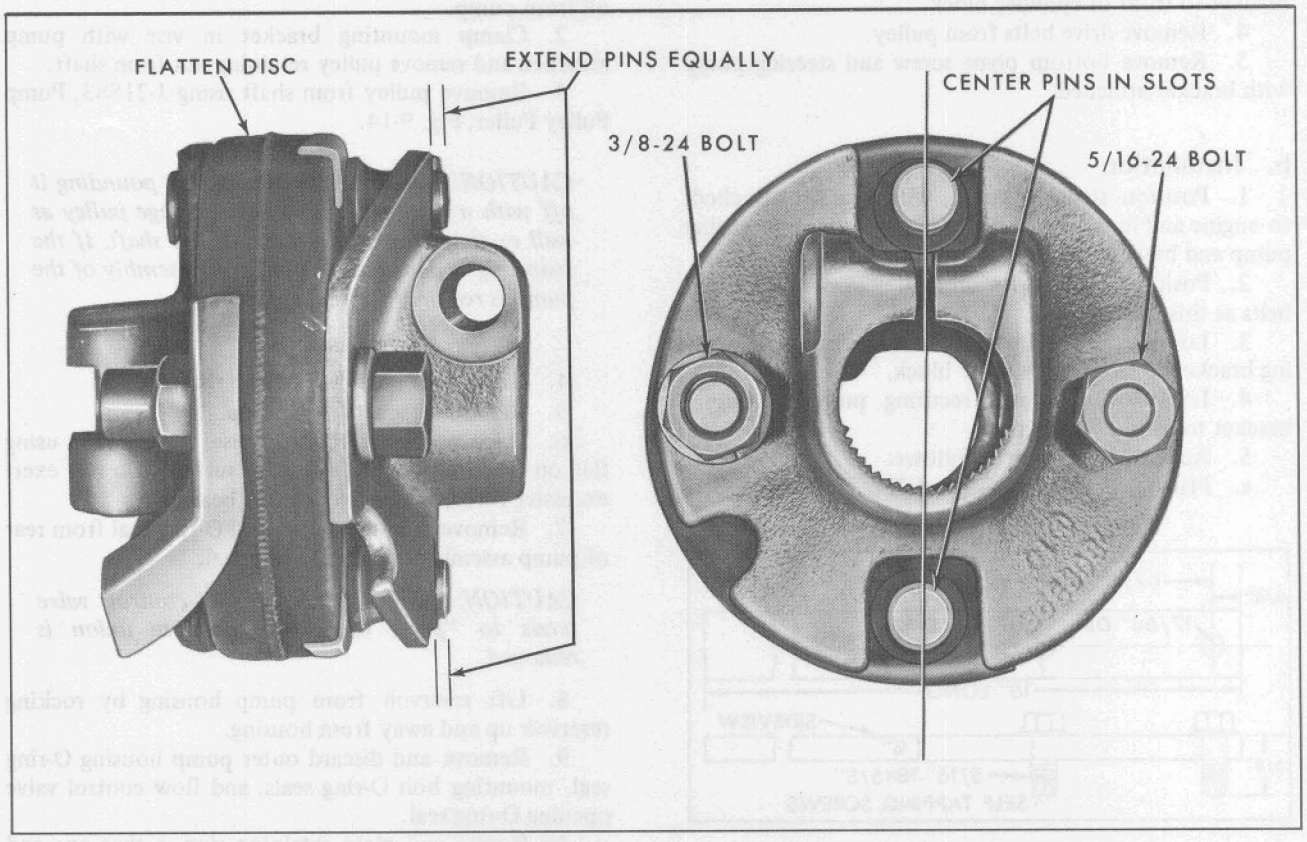


Fig. 9-11 Steering Shaft Flexible Coupling

that is the maximum torque the release capsule can withstand and still provide satisfactory release.

f. Tighten all six lower mounting bracket to toe pan screws to 35 inch-pounds.

10. Adjust shift pointer and tighten attaching screw.

11. Install carpet at lower column support and position rubber carpet seal over carpet.

12. Install steering column lower cover as described in Section 12, Note 41, and recheck for proper operation of assembly. If necessary, repeat step 10.

13. Move column seal downward to cover clearance gap between bezel and shift bowl.

14. Check shift linkage for proper operation. Adjust if necessary as outlined in Section 7, Note 4, for C-cars and Note 21 for "693" cars.

CAUTION: Check adjustment of neutral switch after realigning column to make sure car cannot be started with the shift lever in any of the drive positions. Follow procedure for neutral switch adjustment as outlined in Section 12, Note 32.

7. Steering Pump

a. Removal

1. Disconnect pressure and return lines from pump. Plug all openings to prevent loss of fluid and entrance of dirt into system.

2. Remove nut securing pump mounting bracket to cylinder head stud.

3. Remove adjusting screw securing mounting bracket to front of cylinder block.

4. Remove drive belts from pulley.

5. Remove bottom pivot screw and steering pump with bracket attached.

b. Installation

1. Position steering pump, with bracket attached, to engine and loosely install bottom pivot screw securing pump and bracket to front of cylinder block.

2. Position drive belts on pulley. Do not tension belts at this time.

3. Loosely install adjusting screw securing mounting bracket to front of cylinder block.

4. Loosely install nut securing pump mounting bracket to cylinder head stud.

5. Adjust belt tension as follows:

a. Place Belt Tension Gage, J-23600, on drive belt midway between pulleys at location B, shown in Section 6, Fig. 6-10.

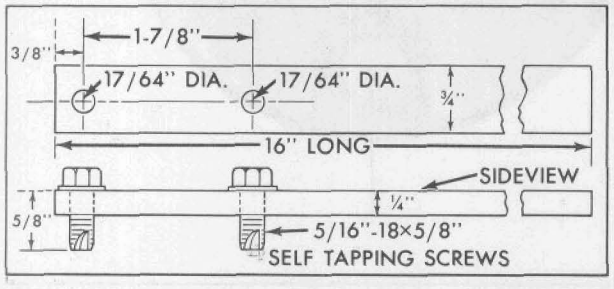


Fig. 9-12 Belt Tensioning Tool

b. Pull pump toward outside of car until correct belt tension is reached on belt tension gage, using the tool illustrated in Fig. 9-12, which can be made from bar steel stock and self-tapping screws. This tool fits into the accommodating holes in the front face of the pump casting behind the pulley. Do not pull or pry on pump reservoir.

(NOTE: Proper tension for a new belt is 100 lbs., and 55-70 lbs. for a belt that has been previously tensioned.)

c. Tighten all mounting and adjusting bolts and nut to 22 foot-pounds.

6. Unplug fittings and connect high pressure line at rear of pump. Tighten fitting to 40 foot-pounds.

7. Unplug fittings and install return hose on fitting at side of pump and secure with clamp. Tighten clamp to 20 inch-pounds.

8. Check fluid level as described in Note 1.

9. Bleed steering gear as described in Note 1, Step 3.

8. Steering Pump Disassembly, Cleaning and Inspection, and Assembly

a. Disassembly (Fig. 9-13)

1. Remove pump as described in Note 7a, and drain oil from pump.

2. Clamp mounting bracket in vise with pump attached and remove pulley retaining nut from shaft.

3. Remove pulley from shaft using J-21883, Pump Pulley Puller, Fig. 9-14.

CAUTION: Never remove pulley by pounding it off with a hammer. This could damage pulley as well as snap ring at inner end of the shaft. If the snap ring is damaged, complete disassembly of the pump is required for replacement.

4. Remove woodruff key from shaft.

5. Remove bracket from pump.

6. Place pump assembly in vise, shaft down, using flat on housing for one clamping surface. Do not exert excessive force, as this may distort bearing.

7. Remove pressure union and O-ring seal from rear of pump assembly. Discard O-ring seal.

CAUTION: Spring loaded flow control valve tends to "pop" out when pressure union is removed.

8. Lift reservoir from pump housing by rocking reservoir up and away from housing.

9. Remove and discard outer pump housing O-ring seal, mounting bolt O-ring seals, and flow control valve opening O-ring seal.

10. Rotate end plate retaining ring so that one end of ring is over hole in housing. Spring one end of ring

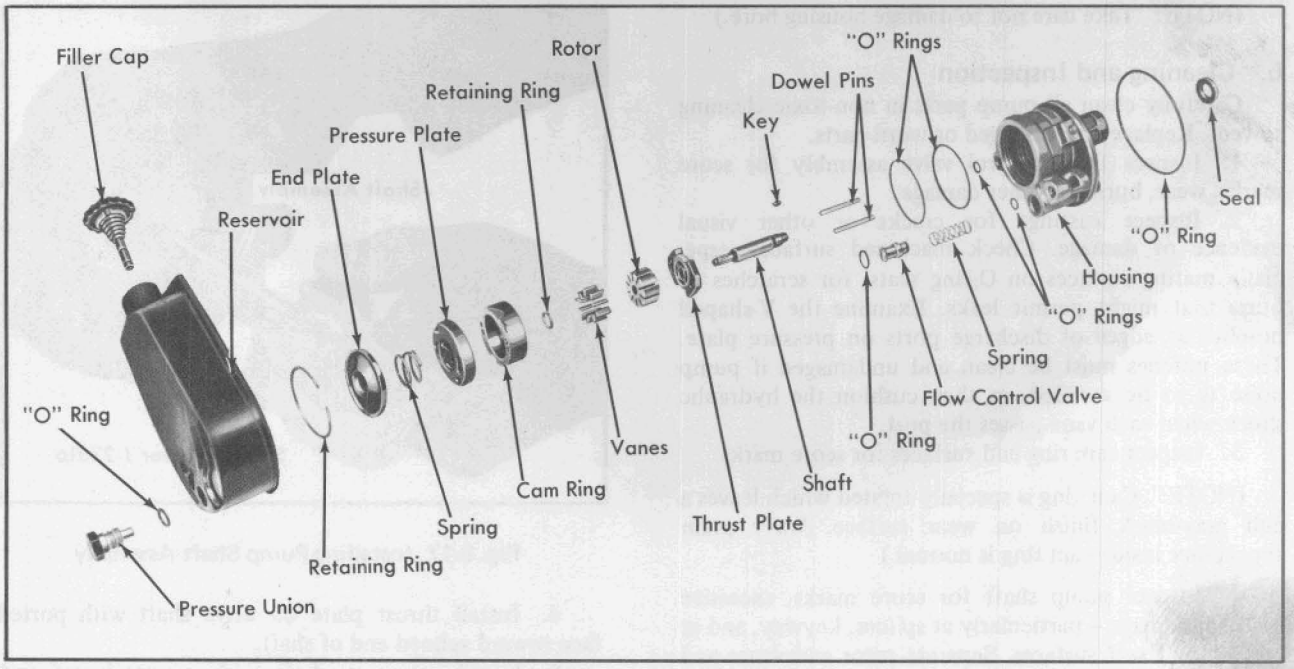


Fig. 9-13 Steering Pump Disassembled

with punch to allow screwdriver to be inserted to lift ring out, Fig. 9-15.

11. Remove end plate. End plate is spring loaded and will generally raise above the housing, making removal easy. However, if end plate should stick, a slight rocking action on top surface will free the plate.

12. Remove pressure plate spring.

13. Remove pressure plate, cam ring, and dowel pins from pump housing.

14. Remove pump from vise, and remove flow control valve and spring. Flow control valve is serviced as a unit and should not be disassembled.

15. Tap end of shaft lightly on bench until shaft is free from pump housing. Then remove shaft with rotor and vanes, and thrust plate attached.

16. Remove vanes from rotor, then remove retaining ring from splined end of shaft and remove rotor and thrust plate from shaft. Discard retaining ring.

(NOTE: To remove retaining ring, clamp shaft in soft jawed vise, and using a pair of long nose pliers or a screwdriver, pry retaining ring off shaft. Be careful not to damage shaft with vise jaws.)

17. Remove pressure plate O-ring seal and end plate O-ring seal from bore of housing and discard.

18. Remove shaft seal by prying out with screwdriver and discard seal.

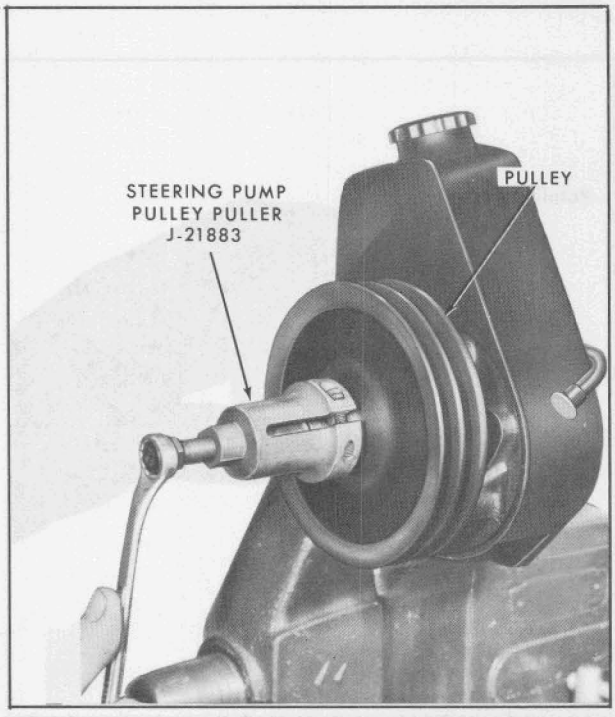


Fig. 9-14 Removing Pump Pulley



Fig. 9-15 Removing End Plate Retaining Ring

(NOTE: Take care not to damage housing bore.)

b. Cleaning and Inspection

Carefully clean all pump parts in non-toxic cleaning solvent. Replace any damaged or worn parts.

1. Inspect flow control valve assembly for score marks, wear, burrs, or other damage.
2. Inspect castings for cracks or other visual evidence of damage. Check machined surfaces, especially mating surfaces on O-ring seats, for scratches or burrs that might permit leaks. Examine the V-shaped notches at edges of discharge ports on pressure plate. These notches must be clean and undamaged if pump noise is to be avoided, as they cushion the hydraulic shock when each vane passes the port.
3. Inspect cam ring end surfaces for score marks.

(NOTE: Cam ring is specially treated which leaves a dull gray-black finish on wear surface. Wavy grain appearance inside cam ring is normal.)

4. Inspect pump shaft for score marks, excessive wear, or damage -- particularly at splines, keyway, and at bearing and seal surfaces. Separate rotor and vanes and inspect for wear and general condition.
5. Inspect shaft bushing in pump housing, and replace pump housing if bushing is scored or excessively worn.
6. If any internal parts are found to be worn or damaged, disassemble gear and clean internal parts.

c. Assembly

1. Lubricate new O-ring seals and seal areas with power steering fluid.
2. Lubricate new shaft seal with power steering fluid and install in housing with metal backing up. Use Seal Installer, J-7728, Fig. 9-16.
3. Install new pressure plate and end plate O-ring seals in grooves in pump housing.

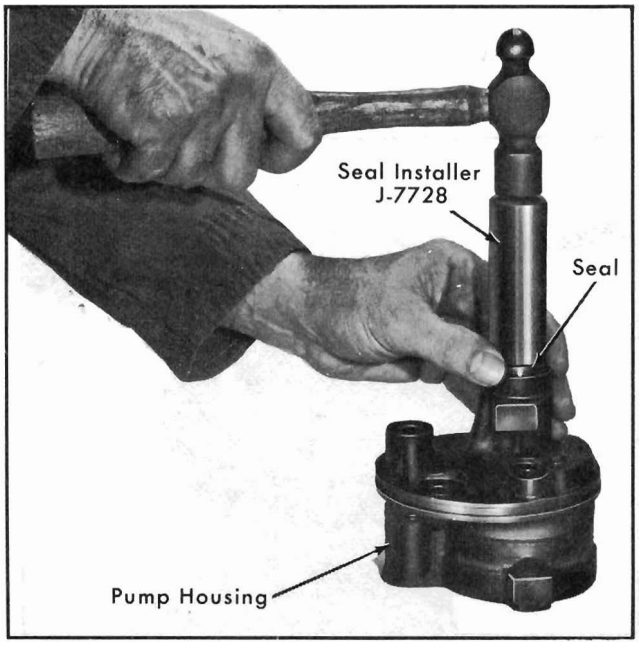


Fig. 9-16 Installing Pump Shaft Seal

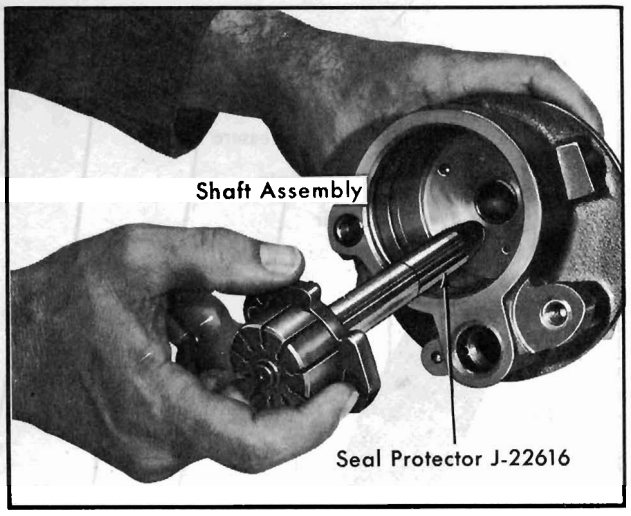


Fig. 9-17 Installing Pump Shaft Assembly

4. Install thrust plate on drive shaft with ported face toward splined end of shaft.
5. Install rotor on shaft with counterbored end toward thrust plate.
6. Clamp shaft in soft jawed vise and install new retaining ring on splined end of shaft by prying ring open and sliding it down over shaft until it seats itself in ring groove. Be careful not to damage shaft.
7. Insert drive shaft with thrust plate and rotor into housing, using Seal Protector, J-22616, Fig. 9-17. Make sure that shaft is properly seated.
8. Place pump housing in vise, hub down, using flat on hub for one clamping surface.
9. Install dowel pins through thrust plate into pump housing.
10. Install cam ring on dowel pins with rotation

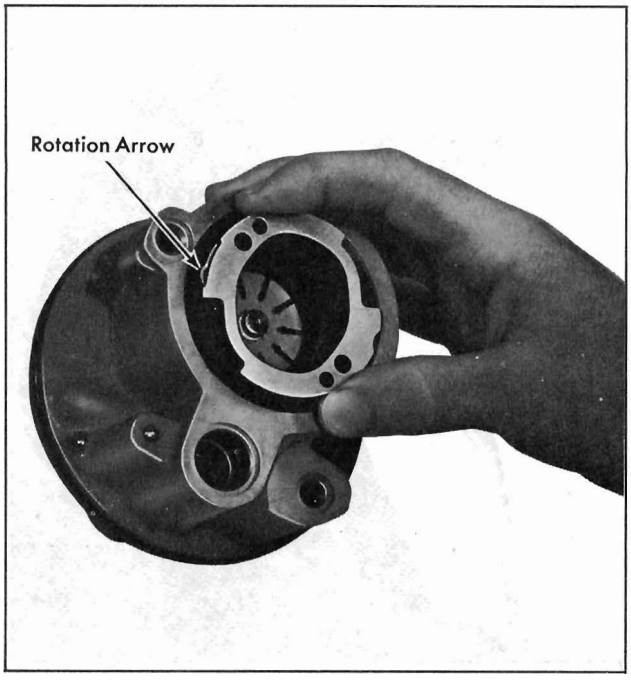


Fig. 9-18 Installing Cam Ring

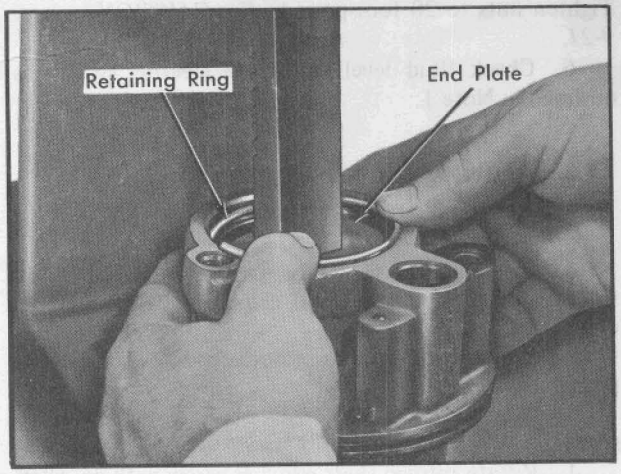


Fig. 9-19 Installing End Plate Retaining Ring

arrow toward rear of pump housing and pointing in direction of pump rotation, Fig. 9-18. Direction of rotation is counterclockwise when viewed from rear of pump.

11. Install vanes in slots in rotor, with radius edges toward outside of rotor, so they ride on cam ring.

12. Lubricate outside diameter of pressure plate with petrolatum or equivalent to prevent damage to O-ring and install pressure plate on dowel pins with ported face toward cam ring. Install plate so that narrow slots in plate engage dowel pins. Make sure that pressure plate is properly seated by tapping lightly around outer circumference with a wooden hammer handle.

13. Install pressure plate spring.

14. Lubricate outside diameter of end plate with petrolatum or equivalent and install end plate in pump housing.

plate below retaining ring groove, and install end plate retaining ring, Fig. 9-19. Make certain that ring is completely seated in groove of housing.

16. Install new outer pump housing O-ring seal, flow control valve opening O-ring seal, and mounting bolt O-ring seals in pump housing.

17. Install reservoir on pump housing. Do not hammer on housing.

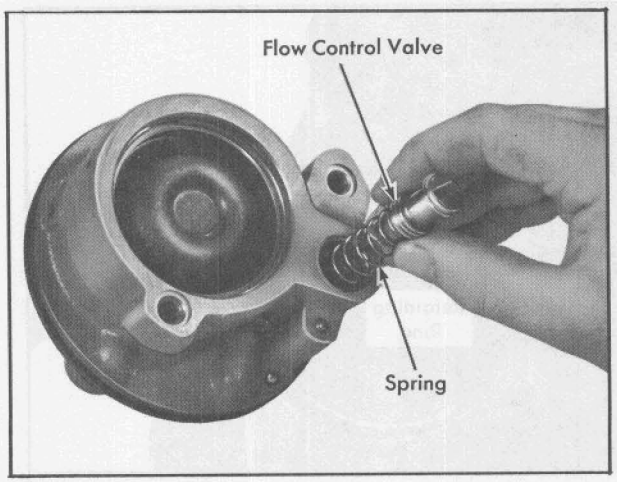


Fig. 9-20 Installing Flow Control Valve

18. Install flow control valve spring.

19. Install flow control valve (hex head screw goes into bore first), Fig. 9-20.

20. Install pressure union using a new O-ring seal. Tighten to 32 foot-pounds.

21. Install mounting bracket on pump and secure with three bolts and lockwashers. Tighten bolts to 32 foot-pounds.

22. Clamp mounting bracket in vise with pump attached.

23. Install woodruff key in shaft.

24. Install pulley on shaft by first aligning key in shaft with keyway in pulley. Position pulley by hand as far on shaft as possible.

25. Install pulley nut, tighten to 47 foot-pounds.

26. Install pump on car as described in Note 7b.

9. Steering Pump Shaft Seal Replacement (Off Car)

Steering pump shaft seal cannot be replaced with pump on car as there is insufficient clearance for application of tools for removing pulley and installing seal. For replacing seal only, proceed as follows:

1. Remove pump from car as described in Note 7a.
2. Clamp mounting bracket in vise with pump attached and remove nut from shaft pulley.
3. Remove pulley from shaft using pulley puller, J-21883, Fig. 9-14.

CAUTION: Never remove pulley by pounding it off with a hammer as this could damage pulley as well as internal parts.

4. Remove woodruff key from pump drive shaft.
5. Remove shaft seal by prying out with sharp tool.

CAUTION: Insert sharp tool between seal and pump housing. Do not pry against pump shaft.

6. Remove pump and mounting bracket from vise and lay flat on bench, allowing return pipe to hang over side of bench, Fig. 9-21, so it will not be damaged when installing new shaft seal.

CAUTION: Pump mounting bracket may be damaged if clamped in vise while installing new shaft seal.

7. Install Seal Protector, J-22616, on pump drive shaft.
8. Position new shaft seal on drive shaft with metal backing facing pulley end of shaft.
9. Install seal, using Pump Shaft Seal Installer, J-7728, Fig. 9-21. Tap tool lightly with small hammer until seal is properly seated in shaft hub.
10. Clamp mounting bracket in vise with pump attached.
11. Install woodruff key in shaft.
12. Install pulley on shaft by first aligning key in shaft with keyway in pulley. Position pulley by hand as far on shaft as possible.
13. Install pulley nut, tighten to 47 foot-pounds.
14. Install pump on car as described in Note 7b.

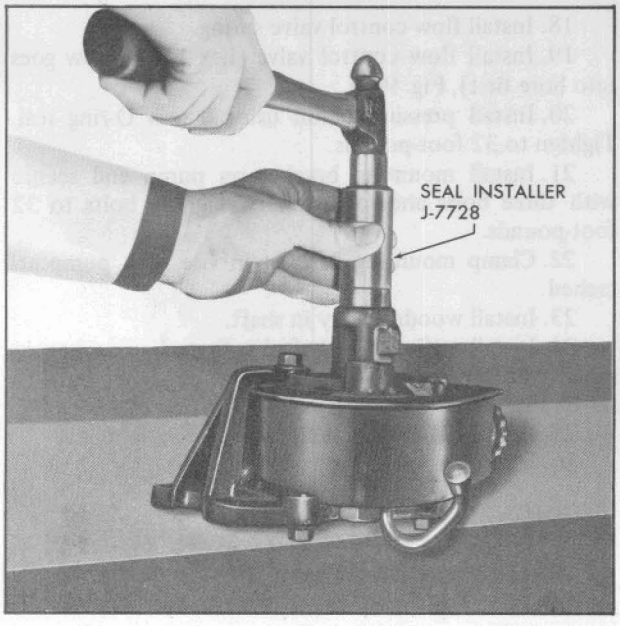


Fig. 9-21 Installing Pump Shaft Seal (Off Car)

10. Steering Gear (Except 693)

a. Removal

1. Position container under gear to catch dripping fluid.

2. Disconnect pressure and return lines at steering gear. Plug all openings to prevent loss of fluid and entrance of dirt into system.

3. Remove two nuts and lockwashers that hold the upper half of the flexible coupling to the lower shaft.

4. Raise car.

5. Remove nut and lockwasher, break pitman arm loose from pitman shaft using Pitman Arm Puller, J-6632, and remove pitman arm from steering gear.

(NOTE: Residual torque on nut after driving may range from 10-200 foot-pounds.)

6. Remove three screws that hold steering gear to frame side rail, lower gear assembly down and out of car with pitman arm attached.

b. Installation

1. Position steering gear to frame side rail so that flexible coupling bolts engage upper flange.

(NOTE: One bolt is 5/16", the other is 3/8".)

Secure gear to side rail with three mounting screws. Tighten screws to 55 foot-pounds. *See CAUTION on page 9-21.*

2. Position pitman arm on pitman shaft and install lockwasher and nut. Tighten nut to 185 foot-pounds to seat arm on shaft. *See CAUTION on page 9-21.*

3. Lower car.

4. Unplug openings and connect pressure and return lines to steering gear. Tighten fittings to 30 foot-pounds.

5. Install 5/16" nut and lockwasher, and 3/8" nut and lockwasher to bolts through the flexible coupling. Tighten nuts to 20 foot-pounds. *See CAUTION on page 9-21.*

6. Check fluid level and bleed steering system as outlined in Note 1.

11. Steering Gear, Removal of Major Components

1. Position gear assembly in vise with end cover tilted upward about 20°, and clamp lower tab at valve end of gear.

2. Remove locknut from adjuster screw on end of pitman shaft and discard.

3. Remove four side cover-to-housing retaining screws.

4. Rotate pitman shaft adjuster screw with an Allen wrench until side cover is lifted free from housing.

5. Separate side cover from pitman shaft. Discard side cover O-ring and gasket assembly if necessary.

6. Rotate gear housing end cover retaining ring so that one end of ring is over hole in housing. Spring one end of ring with punch to allow screwdriver to be inserted to lift ring out, Fig. 9-22.

7. Rotate coupling flange counterclockwise until rack-piston loosens end cover in housing. Remove end cover and O-ring from housing.

CAUTION: Do not rotate any further than necessary or balls will fall out of their circuit and pitman shaft teeth and rack-piston will become disengaged.

8. Remove rack-piston end plug in the following manner.

a. Strike end plug with a plastic mallet to unseat threads.

(NOTE: This is important, as end plug is tightened to 80 foot-pounds during assembly and could break during removal if not handled carefully.

b. Turn flexible coupling flange until pitman shaft teeth are centered in housing.

c. Use a ratchet and a 1/2 inch square drive extension to remove end plug, Fig. 9-23.

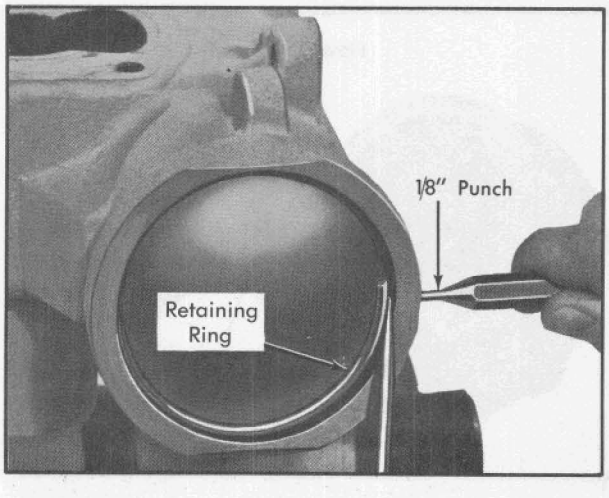


Fig. 9-22 Removing End Cover Retaining Ring

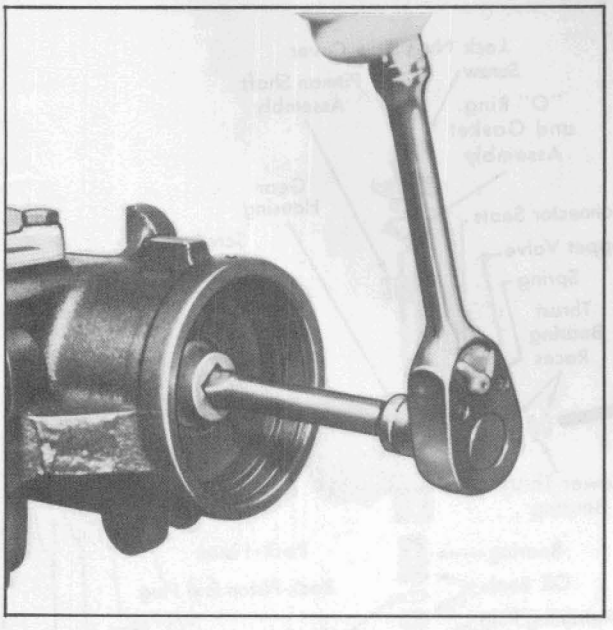


Fig. 9-23 Removing Rack Piston End Plug

9. Tap end of pitman shaft with a soft mallet and slide pitman shaft out of housing. Remove slowly as oil will drain from the housing.

10. Remove housing end plug O-ring seal from housing and discard if not previously removed.

11. Insert Rack-Piston Arbor, J-21552, into rack-piston against end of worm. Turn coupling flange counterclockwise, while holding tool tightly against worm, to force rack-piston on to arbor, and remove rack-piston from gear housing, Fig. 9-24. Do not remove Rack-Piston Arbor from rack-piston until ready to remove balls from rack-piston.

(NOTE: On 693 steering gears the large snap ring visible at the bottom of the bore is a stop. Do not remove this snap ring.)

12. Remove flexible coupling flange retaining screw and remove coupling flange assembly.

13. Remove adjuster plug locknut by breaking it loose with hammer and punch, and remove locknut from housing.

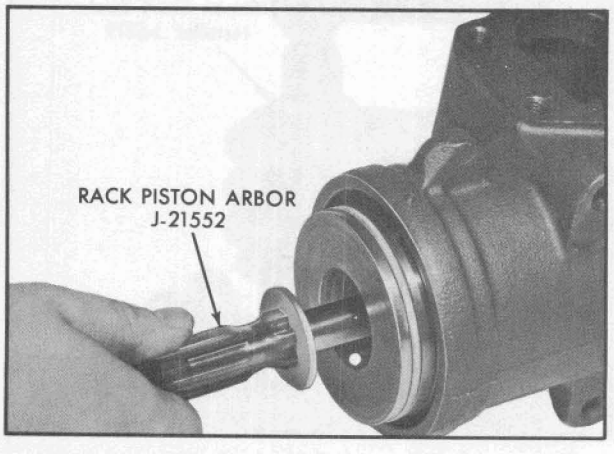


Fig. 9-24 Installing Rack Piston Arbor

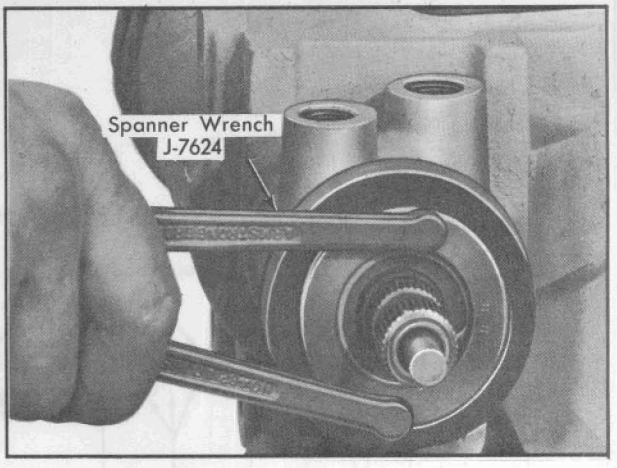


Fig. 9-25 Removing Adjuster Plug

14. Loosen adjuster plug assembly, using Spanner Wrench J-7624, Fig. 9-25, and remove from housing. Remove and discard adjuster plug O-ring.

15. Remove valve assembly by grasping stub shaft and pulling out. Separate worm and shaft and remove and discard lower shaft cap O-ring.

16. Remove worm, lower thrust bearing, and races from upper end of housing.

12. Steering Gear, Disassembly, Inspection, and Assembly of Major Components

Disassembly of the major components within the gear must be performed on a clean workbench. The work area, tools, and parts must be kept clean at all times. Refer to Fig. 9-26 for parts nomenclature and location.

a. Gear Housing, Pitman Shaft Needle Bearing, and Seals

Disassembly

1. Remove pitman shaft seal retaining ring from gear housing, using Snap Ring Pliers, J-4245 (#3), and, then remove outer back-up washer.

2. Drive needle bearing, outer seal, inner backup washer, and inner seal from gear housing bore with Pitman Shaft Bearing Remover, J-6657. Discard seals.

Inspection

1. Inspect pitman shaft and needle bearing for broken or pitted rollers.

2. Inspect housing bore. If badly scored or worn, replace housing.

3. Inspect high pressure line hose connector seat in gear housing. If badly scored, replace as described in Note 14. Inspect poppet and seat and replace if deformed or scored.

4. Inspect low pressure line hose connector seat in gear housing. If badly scored, replace as described in Note 14.

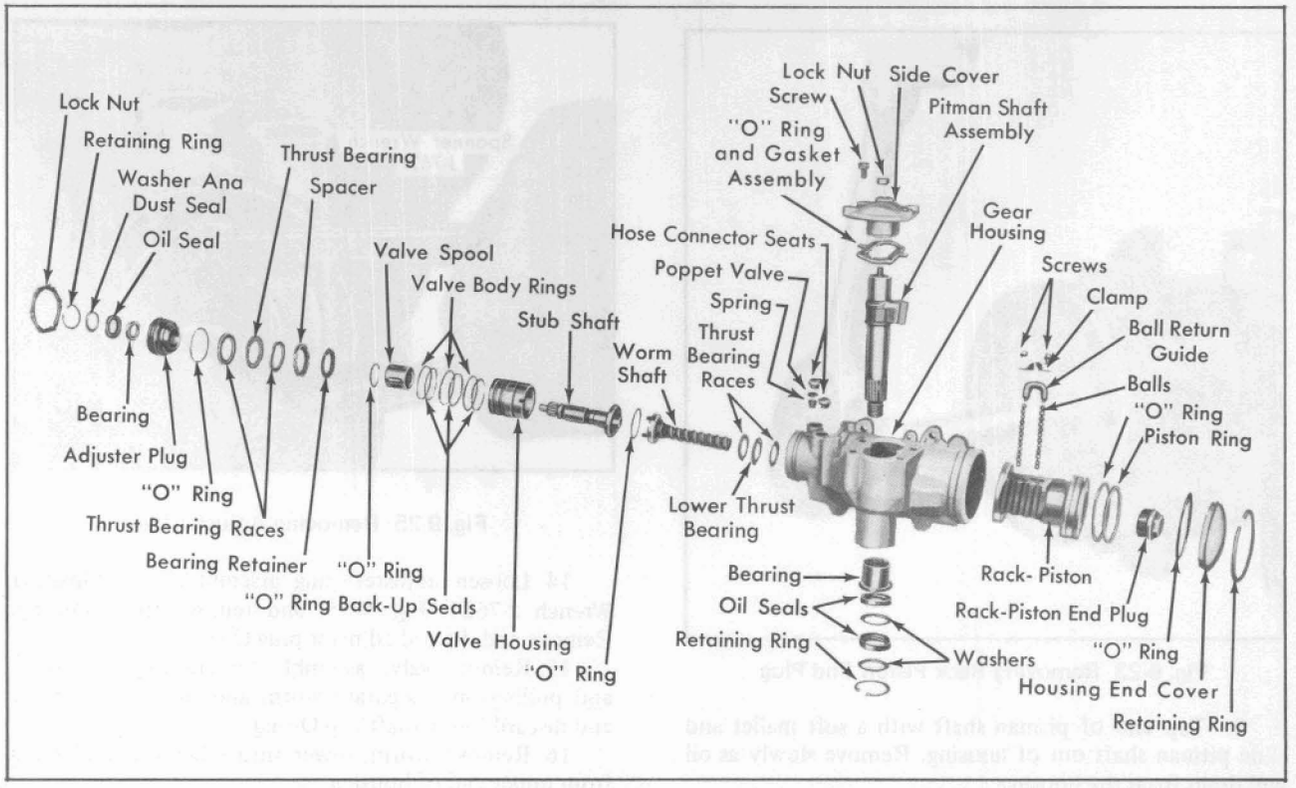


Fig. 9-26 Steering Gear Disassembled

5. Inspect ball plug in valve body end of housing. If it is leaking or raised above the surface, it may be driven in flush or 1/16 inch below surface. Ball can be tightened by staking housing.

6. Inspect all retaining ring grooves and seal surfaces for damage or failure.

Assembly

1. Thoroughly clean the parts and lubricate them with power steering fluid.

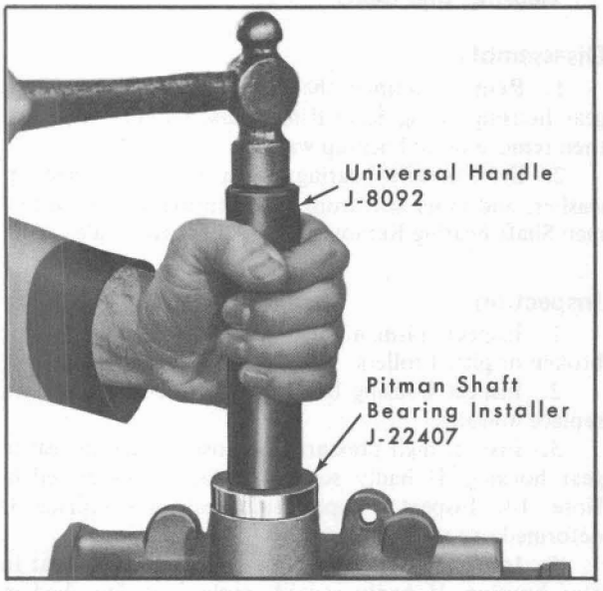


Fig. 9-27 Installing Pitman Shaft Bearing

2. Install pitman shaft needle bearing on Bearing Installer J-22407, with shoulder on bearing against tool. Position bearing and tool in housing and press bearing into housing, until bearing is bottomed out against hub of housing, Fig. 9-27. On constant ratio steering gears press bearing in until bottom edge of bearing is flush with the housing bore surfaces.

3. Lubricate pitman shaft bore and single lip pitman shaft seal with power steering fluid and install seal, lip down, into bore, using Seal Installer, J-6219, Fig. 9-28. Do not drive seal more than 1/8 inch below lip of bore.

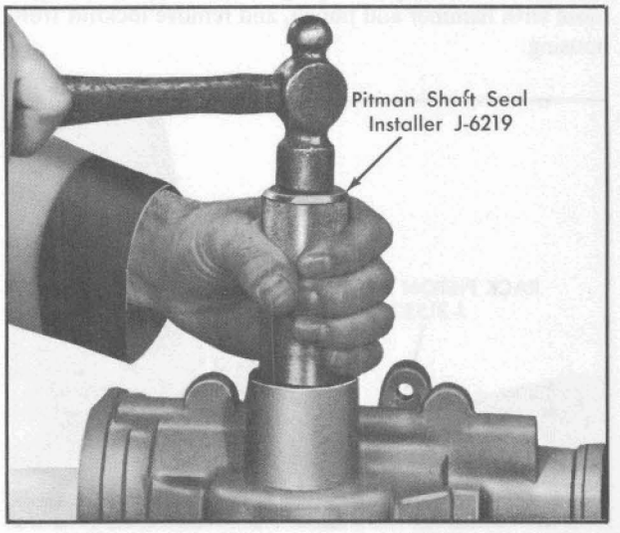


Fig. 9-28 Installing Pitman Shaft Seal

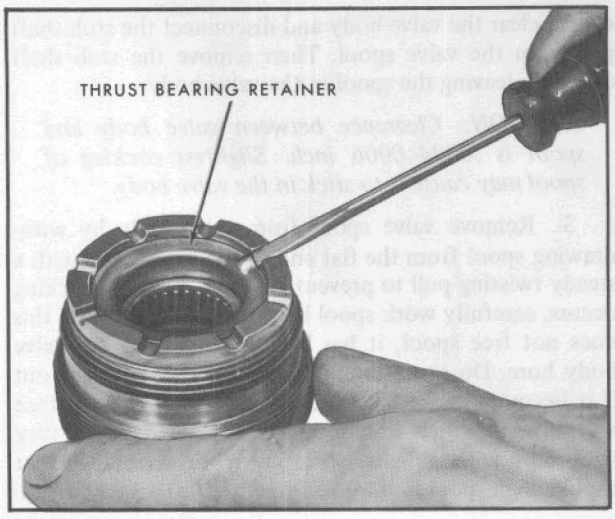


Fig. 9-29 Removing Thrust Bearing Retainer

4. Remove tool and place steel washer on top of seal. Using tool J-6219, drive seal approximately 1/2 inch further into bore.

5. Lubricate double lip seal with power steering fluid and install seal into housing bore. Using Seal Installer, J-6219, drive seal down into bore until top edge of seal is flush with bottom edge of retaining ring groove.

6. Remove tool and place steel washer and retaining ring over seal. Using tool J-6219, drive both seals down into bore until retaining ring falls into retaining ring groove.

(NOTE: In order to avoid possible damage to sealing surface of lower seal, it is important that seals and washers be driven down only far enough so that retaining ring falls into ring groove.)

b. Adjuster Plug Assembly

(NOTE: If replacing oil seal only, install adjuster plug loosely in the gear housing. Remove retaining ring with Snap Ring Pliers, J-4245. Pry out dust seal and oil seal from bore of adjuster plug, being careful not to score the needle bearing bore. To install, follow Steps 2, 3, and 4 under Assembly.)

Disassembly

1. Remove thrust bearing retainer with a screwdriver, Fig. 9-29. Pry alternately on dimples so as not to score needle bearing bore, and discard. Remove thrust bearing spacer, thrust bearing, and thrust bearing races.

2. Remove adjuster plug O-ring seal and discard.

3. Remove stub shaft retaining ring, using Sanp Ring Pliers, J-4245 (#3).

4. Remove combination washer and dust seal and discard.

5. Remove stub shaft oil seal by prying out with screwdriver and discard.

Inspection

1. Inspect needle bearing in adjuster plug. If rollers are broken or pitted, remove needle bearing by pressing

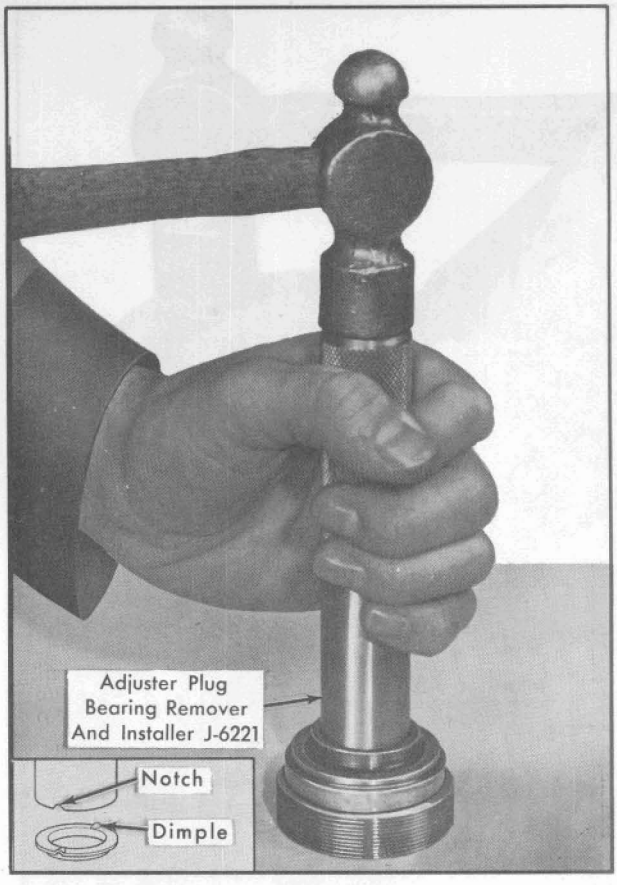


Fig. 9-30 Removing and Installing Adjuster Plug Bearing

out from thrust bearing end, using Adjuster Plug Bearing Remover and Installer, J-6221, Fig. 9-30.

2. Inspect thrust bearing spacer for cracks.

3. Inspect thrust bearing rollers for wear, pitting, scoring, or cracking. If any of these conditions are found, replace bearing and both thrust bearing races.

4. Inspect thrust bearing races for wear, pitting, scoring, cracking, or brinelling. If any of these conditions are found, replace races and check thrust bearing and thrust bearing spacer.

Assembly

1. If adjuster plug needle bearing was previously removed, install new needle bearing on Tool J-6221, with letters on bearings against tool. Position bearing and tool over thrust bearing end of plug and drive bearing into plug, Fig. 9-30. End of bearing must be flush with bottom surface of stub shaft seal bore.

2. Lubricate new stub shaft oil seal with power steering fluid and, using Adjuster Plug Seal Installer, J-5188, Fig. 9-31, install seal far enough to provide clearance for dust seal and retaining ring.

3. Lubricate new dust seal with power steering fluid and install in plug with rubber face outward.

4. Install retaining ring with Snap Ring Pliers, J-4245 (#3), making certain that ring is properly seated.

5. Lubricate new O-ring seal with power steering fluid and install in groove on adjuster plug. Assemble large O.D. thrust bearing race, and thrust bearing, small thrust bearing race, and thrust bearing spacer on adjuster



Fig. 9-31 Installing Oil Seal

plug. Press bearing retainer into needle bearing bore, using a brass or wooden dowel. Radial location of dimples is not important.

(NOTE: Dowel used to install thrust bearing retainer should be notched to clear retainer dimples. Dimples will distort if used as installation surface.)

c. Stub Shaft and Valve Assembly

The complete valve assembly is a precision unit with selective fitted parts hydraulically balanced during assembly. If replacement of any valve part other than rings or seals is necessary, the complete rotary valve assembly must be replaced.

Do not disassemble valve unless absolutely necessary, to avoid possibility of damage to the assembly. If valve spool dampener O-ring requires replacement, remove valve spool as outlined below, replace O-ring and install spool.

Disassembly

1. Remove cap to worm O-ring seal and discard.
2. Remove stub shaft, torsion bar, and valve cap assembly by holding valve assembly in both hands, with thumbs on valve body. Tap torsion bar lightly against workbench. This will dislodge cap from valve body-to-cap pin. Move the assembly forward far enough for the cap to clear the valve body and disconnect the stub shaft pin from the valve spool. Then remove the stub shaft assembly leaving the spool in the valve body.

CAUTION: Clearance between valve body and spool is .0004-.0006 inch. Slightest cocking of spool may cause it to stick in the valve body.

3. Remove valve spool from valve body by withdrawing spool from the flat end of the valve body with a steady twisting pull to prevent jamming. If slight sticking occurs, carefully work spool back into valve body. If this does not free spool, it has become cocked in the valve body bore. Do not attempt to force the spool in or out if it becomes cocked. Visual inspection on a flat surface will show in which direction spool is cocked. A few very light taps with a light, soft plastic or rawhide mallet should align spool in bore and free it.

CAUTION: Do not tap with anything metallic. If spool can be rotated, it can be removed.

Inspection

1. If there is evidence that torsion bar O-ring seal inside stub shaft has been leaking, entire valve assembly should be replaced.
2. Check pin in valve body that engages cap. If it is severely worn, cracked, or broken, the entire valve assembly should be replaced.
3. Check smaller of the two worm pin grooves in valve body. If it is severely worn, entire valve assembly should be replaced.
4. Check spool drive pin on stub shaft. If it is severely worn, cracked, or broken, entire valve assembly should be replaced.
5. Examine spool O.D. for nicks, burrs, or bad wear spots. If any are found, entire valve assembly should be replaced. A slight polishing is normal on valving surfaces.
6. Examine valve body I.D. for nicks, burrs, or bad wear spots. If any are found, entire valve assembly should be replaced. A slight polishing is normal on valving surfaces.
7. Check fit of spool in valve body before installing valve spool dampener O-ring seal.

When lubricated with power steering fluid, spool should rotate smoothly without binding or catching. If either occurs, entire valve assembly should be replaced.

8. Examine needle bearing diameter of stub shaft. If it is badly worn, or scored, entire valve assembly should be replaced.
9. Visually inspect valve body rings. If damaged, carefully cut valve rings and O-ring back-up seals. Remove and discard.

Assembly

1. If new valve body back-up O-ring seals are necessary, lubricate them with power steering fluid. Assemble in ring grooves on valve body. Do not allow seals to become twisted. If new valve rings are necessary, lubricate them with power steering fluid and assemble valve rings in ring grooves over back-up O-ring seals by carefully slipping rings over valve body, Fig. 9-32. Rings may appear to be loose in grooves, but the heat of the oil after assembly will cause them to tighten.

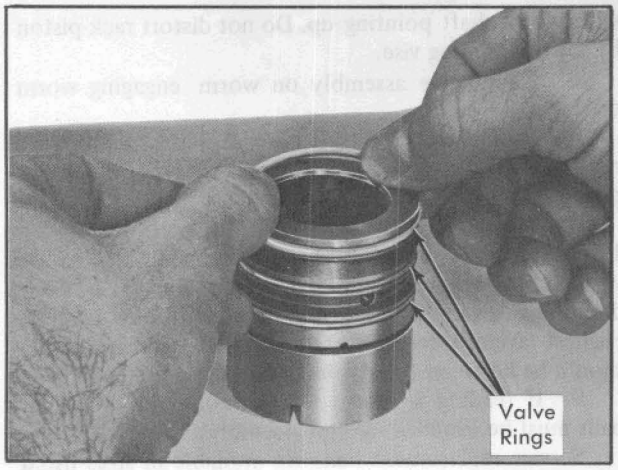


Fig. 9-32 Installing Valve Rings

2. Lubricate new valve spool dampener O-ring seal with power steering fluid and install seal in valve spool groove.

3. Install spool into valve body, Fig. 9-33, sliding it partially through toward notched end.

CAUTION: Because clearance between spool and valve body is .0004-.0006 inch extreme care must be taken when assembling these parts.

4. Insert stub shaft through spool to engage locking pin in spool.

5. Pull spool and stub shaft into valve body aligning stub shaft notch with valve body pin, Fig. 9-34.

6. Lubricate new cap-to-worm O-ring seal with power steering fluid and install in valve body.

(NOTE: Do not install upper thrust bearing assembly on valve assembly at this time.)

d. Pitman Gear Shaft and Side Cover

Inspection

1. Inspect pitman shaft bearing surface in side cover for excessive wear or scoring. If badly worn or scored, replace side cover.

(NOTE: The bearing may extend from the side cover. It is not necessary to reposition the bearing or replace the side cover if this condition occurs.)

2. Visually inspect pitman shaft sector teeth, bearing and seal surface. If abnormally worn, pitted, or scored, replace pitman shaft.

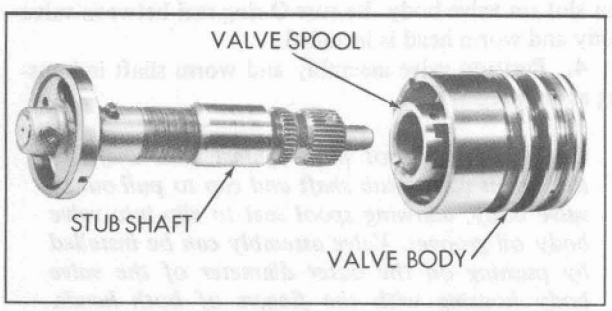


Fig. 9-33 Installing Spool in Body

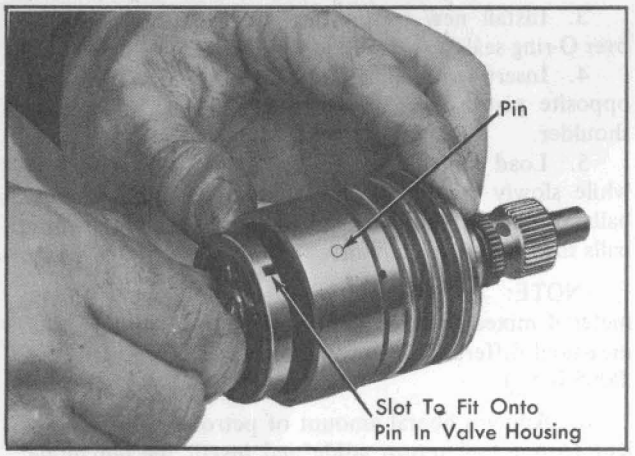


Fig. 9-34 Installing Stub Shaft

e. Rack-Piston and Worm Assembly

Disassembly

1. Place assembly on a clean cloth. Remove return guide clamp screws and remove clamp.

2. Remove ball return guides and Arbor, J-21552. Make sure all 24 balls are caught on the cloth, (22 balls on constant ratio steering gear used in Fleetwood Seventy-Fives, Limousines, and Commercial Vehicles).

(NOTE: Rack-piston ring seldom needs to be replaced.)

Inspection

1. Inspect worm and rack-piston grooves and all of the balls for excessive wear or scoring. If either worm or rack-piston needs replacing, both must be replaced as a matched assembly.

(NOTE: Service replacement balls are available in different sizes as described in this Note under Assembly.)

2. Inspect ball return guides, making sure that the ends where balls enter and leave the guides are not damaged.

3. Inspect lower thrust bearing and races for wear, pitting, scoring, or cracking. If any of these conditions are found, replace thrust bearing and races, and check worm.

4. Inspect rack-piston and end plug to be sure threads are not damaged.

5. Inspect rack-piston teeth for abnormal wear or scoring. Inspect rack-piston O.D. for abnormal wear, scoring, or burrs.

6. Visually inspect piston ring; if damaged, remove ring and back-up O-ring seal and discard.

Assembly

1. Thoroughly clean the parts and lubricate them with power steering fluid.

2. Lubricate new back-up O-ring seal, if necessary, with power steering fluid and install in piston ring groove on rack-piston. Do not allow seal to become twisted.

3. Install new piston ring, if necessary, in groove over O-ring seal.

4. Insert worm into end of rack-piston, from end opposite piston ring, until worm is against rack-piston shoulder.

5. Load 17 balls into guide hole nearest piston ring while slowly rotating worm counterclockwise to feed balls through circuit. Alternate black balls with white balls throughout the circuit.

(NOTE: Balls should be measured with a micrometer if mixed or color identification is questioned. The measured difference between the black and white balls is .0005 inch.)

6. Apply a liberal amount of petrolatum or equivalent to one ball return guide and install the remaining balls into guide, 7 balls on variable ratio gear and 5 balls on constant ratio gear. Place the other guide over the balls and ball guide, and insert guides into guide holes of rack-piston. Make sure black ball in guide is installed next to white ball in rack-piston or vice versa. Guides should fit loosely. It is essential that all balls be positioned so that they are alternate in color. No two balls of the same color are to be side by side.

7. Place return guide clamp over guides and secure with two screws and lockwashers. Tighten screws to 10 foot-pounds.

8. Worm groove is ground with a high point in the center. When rack-piston passes over this high point, a preload of 1 to 4 inch-pounds should be obtained. To measure preload of worm and rack-piston ball assembly, proceed as follows:

a. Clamp rack-piston in a bench vise with soft jaws, with worm shaft pointing up. Do not distort rack-piston by over-tightening vise.

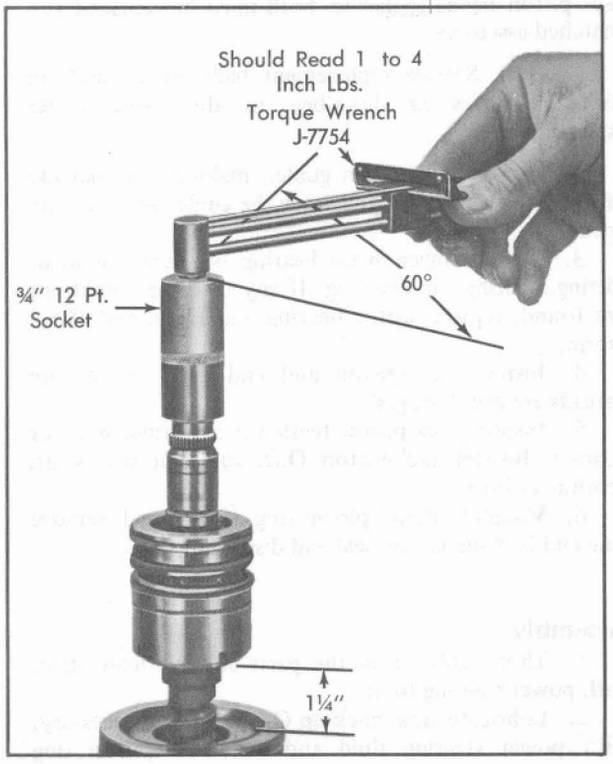


Fig. 9-35 Check Worm and Rack Piston Preload

b. Place valve assembly on worm engaging worm drive pin.

c. Rotate worm until it extends 1-1/4 inches from rack-piston to thrust bearing face. This is center position.

d. Place Torque Wrench, J-7754, with a 3/4 inch 12-point socket on stub shaft, Fig. 9-35, and rotate wrench through an arc of approximately 60° in both directions several times, then take a torque reading. Highest average reading obtained with worm rotating should be between 1 and 4 inch-pounds.

9. If reading is below 1 inch-pound, a new set of balls must be installed upon reassembly.

Service replacement balls are available in sizes listed in the following chart:

Size Code	Mean Dia.	Size Range of Ball
7	.28125	.28120 - .28130
8	.28133	.28128 - .28138
9	.28141	.28136 - .28146
10	.28149	.28144 - .28154

Note the ball size stamped on the rack-piston and install the next size larger balls to increase the preload.

(NOTE: If no number is found on the rack-piston, the original ball size was #7.)

A change of one ball size (higher size code) will increase preload approximately 1 inch-pound. Final preload on replacement balls should be 2 to 3 inch-pounds.

10. Remove valve assembly from worm.

11. Remove rack-piston from vise.

12. Insert Worm Gear Ball Arbor, J-21552, into worm and turn rack-piston onto arbor. Do not allow arbor to separate from worm until rack-piston is fully on arbor.

13. Steering Gear, Installation of Major Components

1. Position gear housing horizontally in vise and clamp lower tab at valve end of gear as shown in Fig. 9-40.

2. Lubricate worm shaft, lower thrust bearing, and races with power steering fluid, then position thrust bearing and races on worm.

3. Align valve body drive pin on worm with narrow pin slot on valve body. Be sure O-ring seal between valve body and worm head is installed.

4. Position valve assembly and worm shaft in housing as an integral unit.

CAUTION: Do not push against stub shaft, as this might cause stub shaft and cap to pull out of valve body, allowing spool seal to slip into valve body oil grooves. Valve assembly can be installed by pushing on the outer diameter of the valve body housing with the fingers of both hands.

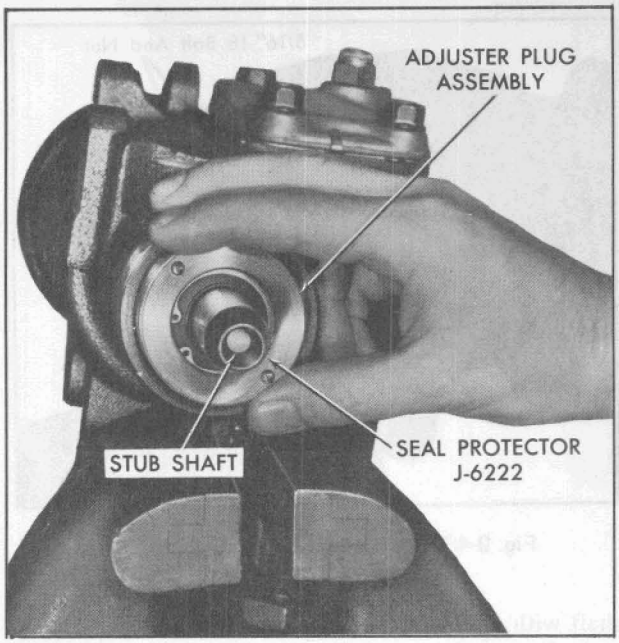


Fig. 9-36 Installing Adjuster Plug

Make certain that white plastic rings are not binding on inside of housing. Valve assembly is properly seated when oil return hole in gear housing is fully visible.

5. Place Adjuster Plug Seal Protector, J-6222, over end of stub shaft.

6. Lubricate new adjuster plug O-ring seal with power steering fluid and install in groove on adjuster plug.

7. Install adjuster plug assembly over end of stub shaft, Fig. 9-36, and tighten just enough to make certain that all parts are properly seated in gear housing. Remove Seal Protector, J-6222.

(NOTE: If Seal Protector, J-6222 is removed too soon, stub shaft seal will be damaged by the shaft splines.)

8. Install adjuster plug locknut loosely on adjuster plug.

(NOTE: Do not adjust thrust bearing preload at this time.)

9. Install Rack-Piston Seal Compressor, J-7576, in gear housing, Fig. 9-37, holding it tightly against shoulder in housing.

10. Insert rack-piston into housing until arbor engages worm. Turn stub shaft clockwise, using a 3/4 inch twelve-point socket or box end wrench, to draw rack-piston into housing. When piston-ring is in housing piston bore, Arbor J-21552, and Seal Compressor, J-7576, can be removed.

11. Turn stub shaft as necessary until middle rack groove in rack-piston is aligned with center of pitman shaft needle bearing.

12. Lubricate new side cover O-ring and gasket assembly and install in face of side cover.

(NOTE: Three tabs on gasket protrude from side cover. Gasket must be installed such that when gear is installed on car, smallest tab faces right rear of car. Two large tabs are then peened over side cover to hold gasket in place.)

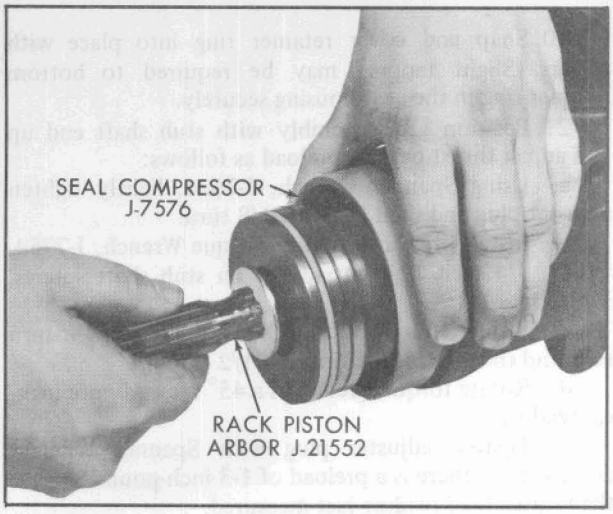


Fig. 9-37 Installing Rack Piston

13. Assemble side cover on pitman shaft by screwing cover onto pitman shaft adjuster screw until side cover bottoms on pitman shaft, and back off 1/2 turn.

14. Install pitman shaft so that center tooth in sector meshes with center groove of rack-piston. Make sure side cover O-ring and gasket assembly is in place before pushing side cover down on gear housing.

15. Install side cover screws and tighten to 30 foot-pounds.

16. Hold adjuster screw with Allen wrench and install new adjuster lock nut half way on adjuster screw.

17. Install rack-piston end plug in rack-piston. Tighten end plug to 80 foot-pounds.

18. Lubricate new housing end cover O-ring seal with power steering fluid and install in gear housing.

19. Insert end cover into gear housing and seat against O-ring seal. Slight tapping with a mallet may be necessary to seat end plug properly.

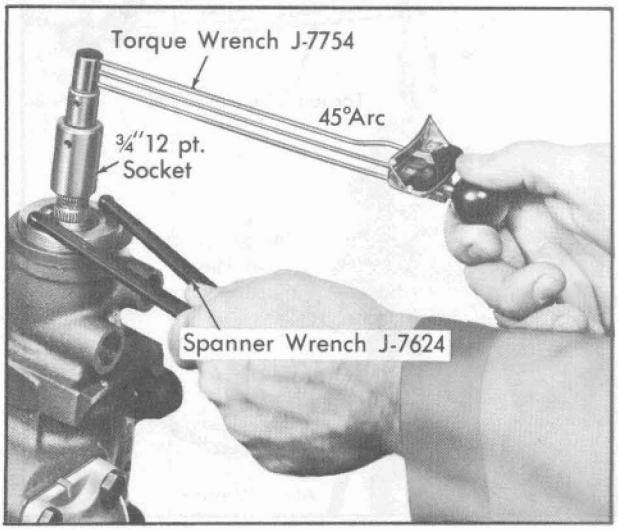


Fig. 9-38 Adjusting Thrust Bearing Preload

20. Snap end cover retainer ring into place with fingers. Slight tapping may be required to bottom retainer ring in the gear housing securely.

21. Position gear assembly with stub shaft end up and adjust thrust bearing preload as follows:

a. Using Spanner Wrench, J-7624, lightly tighten adjuster plug and then back off 1/8 turn.

b. Install 0-25 inch-pound Torque Wrench, J-7754, with a 3/4 inch 12-point socket on stub shaft splines, Fig. 9-38.

c. Rotate stub shaft to either the left or right turn stop and then back off from stop 1/2 turn.

d. Rotate torque wrench in a 45° arc and note highest reading.

e. Tighten adjuster plug with Spanner Wrench, J-7624, until there is a preload of 1-3 inch-pounds higher than initial load reading just measured.

f. Tighten adjuster plug locknut securely with punch and hammer.

g. Recheck preload to be sure it still reads 1-3 inch-pounds higher than initial load. If adjustment has changed, readjust.

22. Adjust pitman shaft end play as follows:

a. Rotate stub shaft from one stop to the other and locate center of travel.

b. With gear on center, check combined ball and thrust bearing preload with Torque Wrench, J-7754, with a 3/4 inch 12-point socket, and note highest reading, Fig. 9-39.

c. With pitman gear on center and adjuster screw locknut backed off, adjust pitman shaft so that preload is 8-10 inch-pounds in excess of total preload and drag.

(NOTE: These readings should be made by rotating torque wrench in an arc from 60° before center to 60° after center. Total preload of gear should not exceed 20 inch-pounds.)

d. With gear on center and reading obtained, tighten adjuster screw locknut to 32 foot-pounds.

23. Install flexible coupling flange assembly on stub shaft with .040 inch clearance between the adjuster plug and the coupling. Install flange screw in coupling. Tighten screw to 30 foot-pounds.

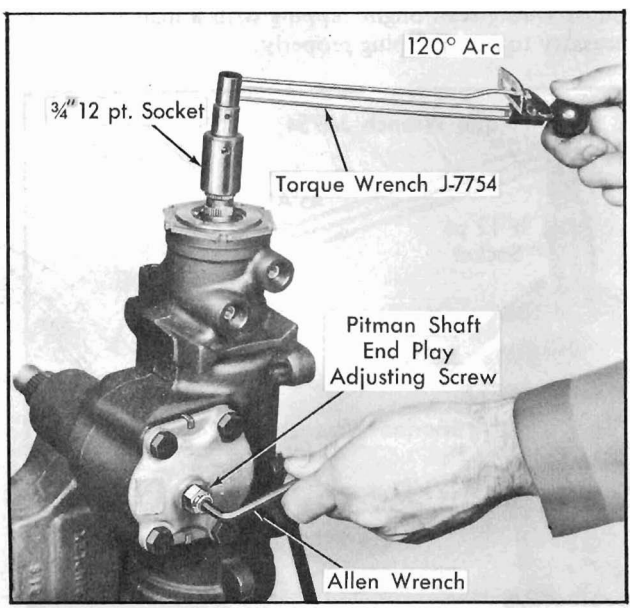


Fig. 9-39 Adjusting Pitman Shaft End Play

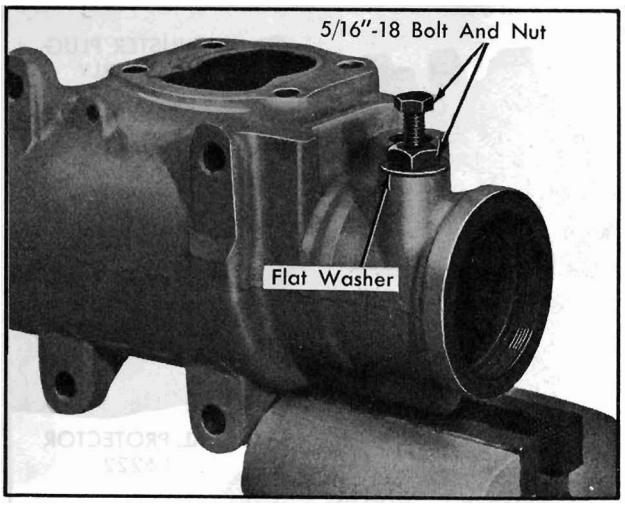


Fig. 9-40 Removing Line Connector Seat

14. Steering Gear Line Connector Seats and Poppet Check Valve Replacement

The following procedure can be performed on car as well as on bench.

1. Disconnect pressure and return lines at steering gear and plug lines to prevent loss of fluid.

2. To prevent metal chips from becoming lodged in valve assembly, pack inside of connector seats of pressure and return port housing with petrolatum or equivalent.

3. Tap threads in connector seats, using a 5/16"-18 tap.

CAUTION: Do not tap threads too deep in pressure hose connector seat as tap will bottom poppet valve against housing and damage it. It is necessary to tap only 2 or 3 threads deep.

4. Thread a 5/16"-18 bolt with a nut and flat washer into tapped hole, Fig. 9-40.

5. To pull connector seat, hold bolt from rotating while turning nut off bolt. This will pull connector from housing. Discard connector seat.

(NOTE: It is also possible to remove connector by using a No. 4 screw extractor.)

6. Wipe lubricant from housing and clean housing thoroughly to remove any metal chips or dirt.

7. Remove poppet check valve and spring from pressure port and discard.

8. Install new check valve spring in pressure port with large end down. Make sure spring is seated in counterbore in pressure port.

9. Install new check valve over spring with tangs pointing down. Make sure valve is centered on small end of spring.

10. Install new connector seats, using petrolatum or equivalent to hold connector seat on check valve in

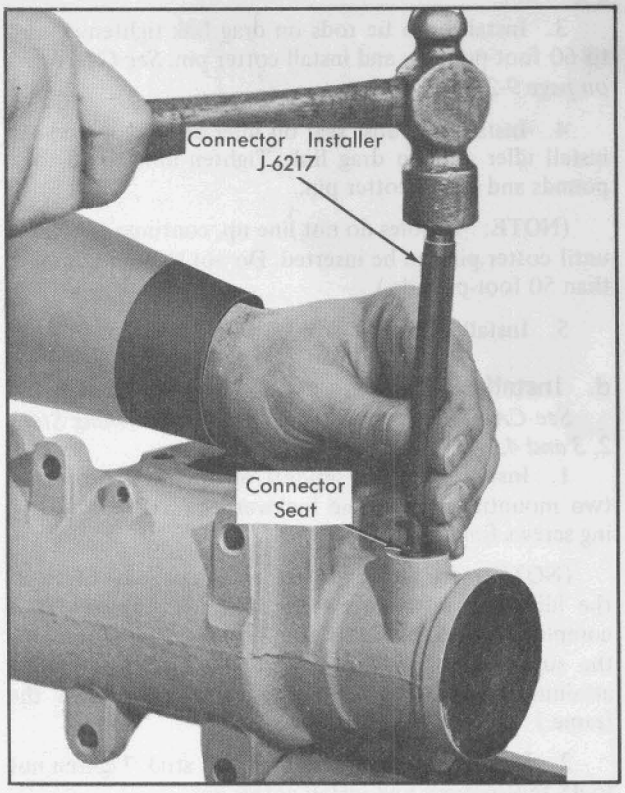


Fig. 9-41 Installing Line Connector Seat

pressure port. Drive connector seats in place using Valve Connector Seat Installer, J-6217, Fig. 9-41.

11. Check operation of valve by pushing lightly against valve with a small punch or small rod. Valve should reseat itself against connector seat when pressure is removed from spring.

12. Connect pressure and return lines on steering gear. Tighten fittings to 30 foot-pounds.

13. Check fluid in pump reservoir and add if necessary.

15. Removal and Installation of Pitman Shaft Seals (On Car)

If upon inspection of the gear, it is found that oil leakage exists at the pitman shaft seals, the seals may be replaced without removing the gear assembly from the vehicle as follows:

a. Removal

1. Remove pitman nut and disconnect pitman arm from pitman shaft using Puller, J-6632.

CAUTION: Do not hammer on end of puller.

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during assembly.

(NOTE: Use only one layer of tape. An excessive amount of tape will not allow seals to pass, due to close tolerance between seals and pitman shaft.)

3. Remove pitman shaft seal retaining ring with Snap Ring Pliers, J-4245.

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

(NOTE: Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out. If pressure of oil does not remove seals, turn off engine and pry seals, being careful not to score seal bore in housing.)

b. Installation

1. Inspect seals for damage to rubber covering on O.D. If O.D. appears scored, inspect housing for burrs and remove before attempting new seal installation.

2. Clean end of housing thoroughly so that dirt will not enter housing with the installation of new seals.

3. Lubricate the seals thoroughly with power steering fluid to install seals with Installer, J-6219. Install inner single lip seal first, then back-up washer. Drive seal in far enough to provide clearance for outer seal, back-up washer, and retaining ring. Make sure that the inner seal does not bottom on counterbore. Install outer double lip seal and second back-up washer just far enough to provide clearance for the retaining ring. Install retaining ring.

4. Fill pump reservoir to proper level with power steering fluid. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks.

5. Remove tape and reconnect pitman arm, tightening nut to 185 foot-pounds. *See CAUTION on page 9-21.*

16. Steering Linkage Removal, Disassembly, Assembly, and Installation (Except 693)

a. Removal

1. Remove cotter pins from outer tie rod pivots at steering arms and loosen nuts one turn.

2. Remove outer tie rod pivots from steering knuckles using Tie Rod End Puller, J-8990-01, Fig. 9-42. Be careful not to damage joint seals.

3. Remove idler arm support mounting screws and lockwashers from frame side member.

4. Remove pitman arm cotter pin, nut and washer at steering linkage.

5. Remove steering linkage from pitman arm, using Puller, J-8990-01, Fig. 9-28.

6. Remove drag link with tie rods and idler arm attached.

b. Disassembly

1. Remove cotter pins and nuts from idler arm pivot and both inner tie rod pivots.

2. Remove tie rods, using Tie Rod End Puller, J-21930, Fig. 9-43.

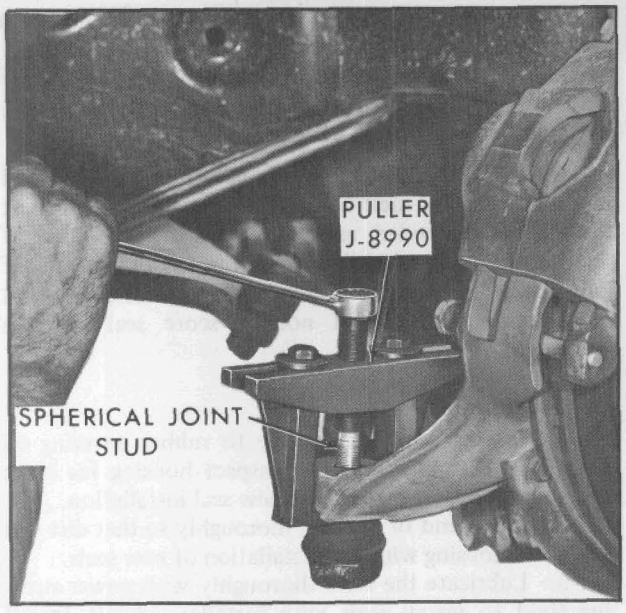


Fig. 9-42 Removing Tie Rod End from Steering Knuckle

3. Remove idler arm from drag link, using Puller, J-21930.

4. Remove dust seals from pitman arm and idler arm pivot studs.

5. Remove outer tie rod pivots by loosening nuts on outer clamp bolts and unscrewing outer tie rod pivots from adjuster tubes. Be careful not to pull pivot seal off pivot housing.

6. If necessary, remove clamps and adjuster tubes from ends of tie rods.

c. Assembly

1. If previously removed, lubricate adjuster tubes with chassis lubricant. Install adjuster tubes and clamps on ends of rods.

2. Thread outer tie rod pivots into adjuster tubes, but do not tighten outer clamps.

(NOTE: An equal amount of thread must be exposed on both ends of the adjuster tubes.)

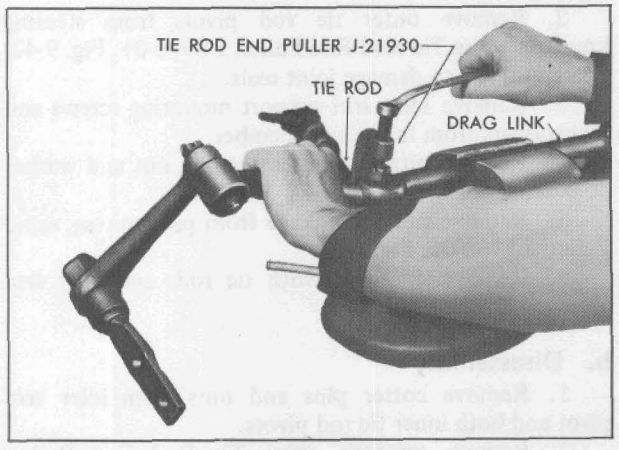


Fig. 9-43 Removing Tie Rod from Drag Link

3. Install both tie rods on drag link tightening nuts to 60 foot-pounds, and install cotter pin. *See CAUTION on page 9-21.*

4. Install new dust seal on idler arm pivot stud and install idler arm on drag link. Tighten nuts to 40 foot-pounds and install cotter pin.

(NOTE: If holes do not line up, continue to tighten until cotter pin can be inserted. Do not tighten nut more than 50 foot-pounds.)

5. Install new dust seal on pitman arm pivot stud.

d. Installation

See CAUTION on page 9-21, when performing Steps 2, 3 and 4.

1. Install idler arm support on frame side bar with two mounting screws and lockwashers. Tighten mounting screws finger tight.

(NOTE: To assure proper rotational capability of the idler arm pivot, screw the idler arm support shaft completely into the idler arm bushing. Then, unscrew the support shaft between 90° and 270° rotationally attaining alignment of the mounting holes with the frame.)

2. Install pitman arm at drag link stud. Tighten nut to 45 foot-pounds and install cotter pin.

(NOTE: If holes do not line up, continue to tighten until cotter pin can be inserted. Do not tighten nut more than 50 foot-pounds.)

3. Connect outer tie rod pivots to steering knuckles, tighten nuts to 37 foot-pounds and install cotter pins.

(NOTE: If holes do not line up, continue to tighten until cotter pin can be inserted. Do not tighten nut more than 50 foot-pounds.)

4. Turn steering wheel back and forth through the straight ahead position (without touching wheel stops) to align linkage. Then tighten idler arm bracket to frame attaching screws to 35 foot-pounds.

5. Adjust toe-in as described in Section 3, Note 2e.

17. Tie Rod End Seal Replacement

1. Raise car.

2. If replacing outer tie rod end seal on 693 style, remove front wheel.

3. Remove cotter pin and nut from outer tie rod pivot.

4. Remove outer tie rod pivot from steering knuckle using Tie Rod End Puller, J-8990-01, Fig. 9-42. Remove inner tie rod pivot from drag link using Tie Rod End Puller, J-21930, Fig. 9-43.

5. Pry old seal off pivot housing.

6. Wipe pivot and housing clean.

7. Position new seal on pivot stud. Using Seal Installer, J-21150-1, move flange of seal over seat on housing with a firm, even push.

(NOTE: Make certain that seal installer is positioned squarely on seal.)

8. Position tie rod to steering knuckle or drag link and install nut. Tighten nut on outer tie rod pivot to 37 foot-pounds. Tighten inner tie rod pivot nut to 60 foot-pounds. *See CAUTION on page 9-21.*

9. Secure pivot nut with cotter pin.

(NOTE: If holes do not line up, continue to tighten nut until cotter pin can be inserted.)

10. Remove service plug from pivot.

11. Using Spherical Joint Repacking Gun, J-9280, repack tie rod end until grease is expelled at lip of seal.

CAUTION: Be sure special spherical joint lubricant is used for this purpose. Ordinary chassis lubricant is not sufficient for this application.

12. Install service plug in pivot.

13. If outer pivot seals were replaced on 693, install front wheel.

14. Lower car.

18. Steering Wheel

a. Removal

CAUTION: Under no circumstances should the steering shaft be struck on the end in an effort to remove the steering wheel. This action will damage delicate parts of the steering column.

1. Remove three screws from back of spokes and lift pad assembly from wheel.

2. Remove horn contact wire from plastic tower by pushing in on wire and turning counterclockwise. Wire will then spring out of tower.

(NOTE: Turn ignition to On to facilitate removal.)

3. On Tilt and Telescope wheel proceed with steps 4 thru 6. On standard wheels proceed to step 7.

4. Remove three screws securing the telescope locking lever assembly to flange and screw assembly.

5. Unscrew flange and screw assembly from steering shaft and remove.

6. Remove locking lever assembly.

7. Scribe an alignment mark on steering wheel hub in line with slash mark on steering shaft to be used at time of installation.

8. Loosen nut on steering shaft positioning it flush with end of shaft.

9. Carefully install Steering Wheel Puller, J-1859-03 with two 5/16"-18 x 4" bolts.

10. Tighten center bolt until steering wheel is loose on shaft, Fig. 9-44.

11. Remove puller.

12. Remove steering shaft nut.

13. Lift wheel off steering shaft.

CAUTION: When laying wheel face down, place a cloth on work bench to prevent laminated chrome, wood grain or stripes from being scratched or marked.

b. Installation

1. Install steering wheel, aligning scribe mark on hub with slash mark on end of shaft.



Fig. 9-44 Steering Wheel Removal

CAUTION: The steering wheel should not be driven on the steering shaft. This action may cause damage to the steering column components.

2. On Tilt and Telescoping columns, proceed to steps 3 through 7. On standard columns, proceed to step 8.

3. Install steering shaft nut and tighten it to 30 foot-pounds. *See CAUTION on page 9-21.*

4. Install locking lever assembly on steering wheel.

5. Screw flange and screw assembly finger tight into steering shaft.

6. Position locking lever assembly against flange and screw assembly with lever in vertical position. Secure with three screws. Check operation of lever after tightening screws to assure proper release and tightening of telescoping shaft.

7. Check operation of telescoping mechanism by rotating locking lever against stops. Check to see that wheel is free to telescope in left position and is securely locked in right position.

(NOTE: When lever is securely locked, it should not contact steering wheel slot. If necessary, readjust as described in steps 5 and 6.)

8. Insert horn contact wire into plastic tower by pushing in against spring pressure and turning to the right to lock in position.

9. Position pad assembly on wheel and secure with three screws from rear side of wheel.

c. Alignment

In the event the steering wheel spokes are "off-center" when the car is being driven down the road, it will be necessary to align steering wheel or front wheels as described below:

1. Check steering wheel for proper position on steering shaft. With steering wheel "centered" in car, slot in flexible coupling upper shaft flange should be facing

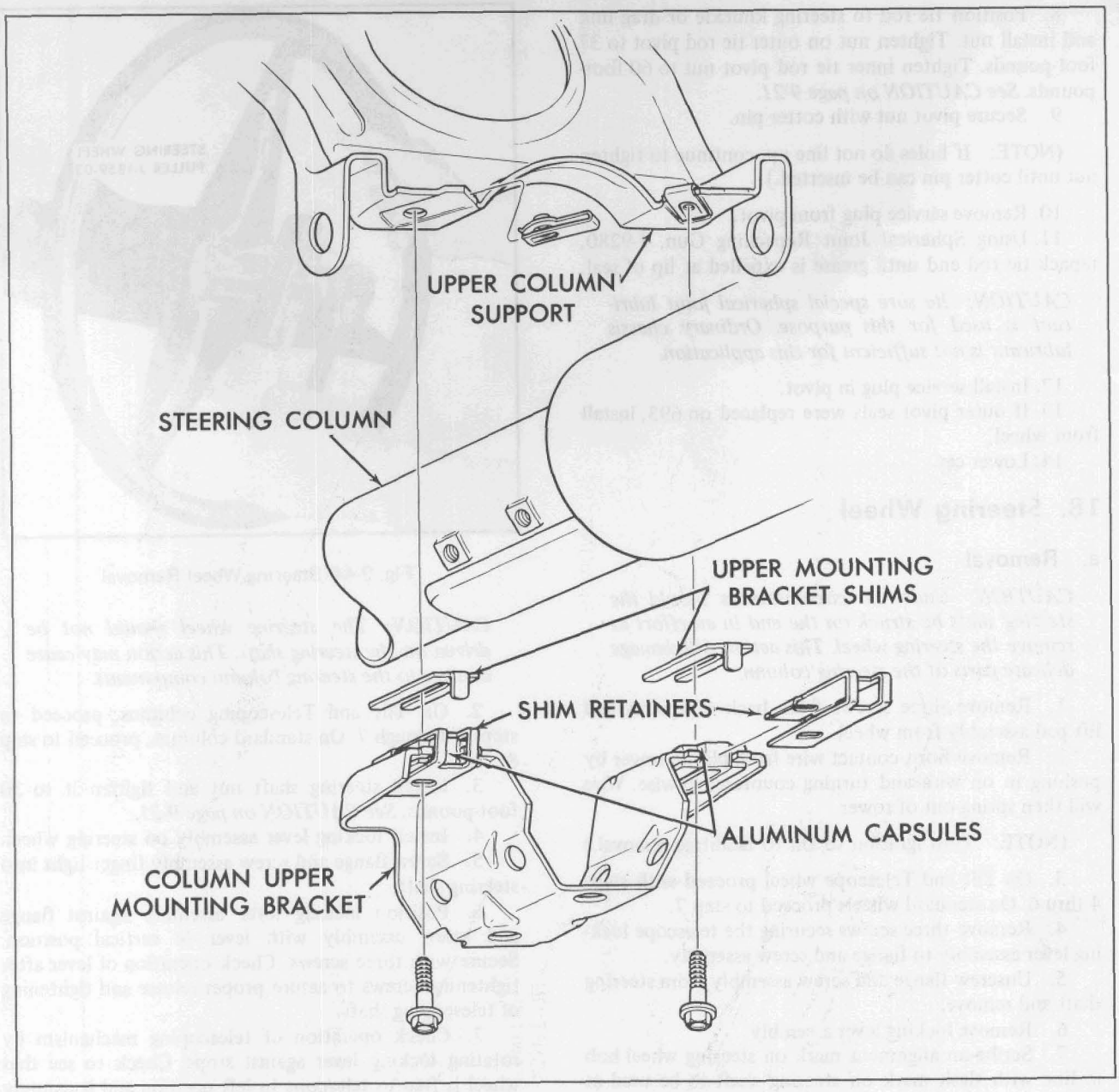


Fig. 9-45 Installing Steering Column Shims

upward with scribe mark on upper end of steering shaft at "12 o'clock". If necessary, reposition steering wheel on shaft.

2. Drive car on a straight flat road to determine whether or not steering wheel is still "off-center".

3. If steering wheel is still "off-center", mark top of the wheel with a small piece of tape or crayon for reference when making correction.

4. Set wheel straight ahead and adjust tie rods. Shorten left tie rod and lengthen right tie rod if top of wheel is to the left of center, or shorten right tie rod and lengthen left tie rod if top of wheel is to the right of center. Be careful not to damage joint seals when adjusting tie rods.

(NOTE: Tie rod adjustment must be made on a wheel alignment machine so that correct toe-in setting is maintained.)

19. Steering Column Removal and Installation

a. Removal

1. Center steering wheel to gain access to flexible coupling pinch bolt.

2. Raise hood and disconnect negative battery cable.

3. Disconnect linkage at lower shift lever.

4. Remove clamp screw and lockwasher that secure flexible coupling upper flange to steering shaft on "C" cars. On 693 series cars, remove lower steering shaft as described in Note 26a.

5. Remove steering column lower cover as described in Section 12, Note 41.

6. Disconnect turn signal wiring at connector.

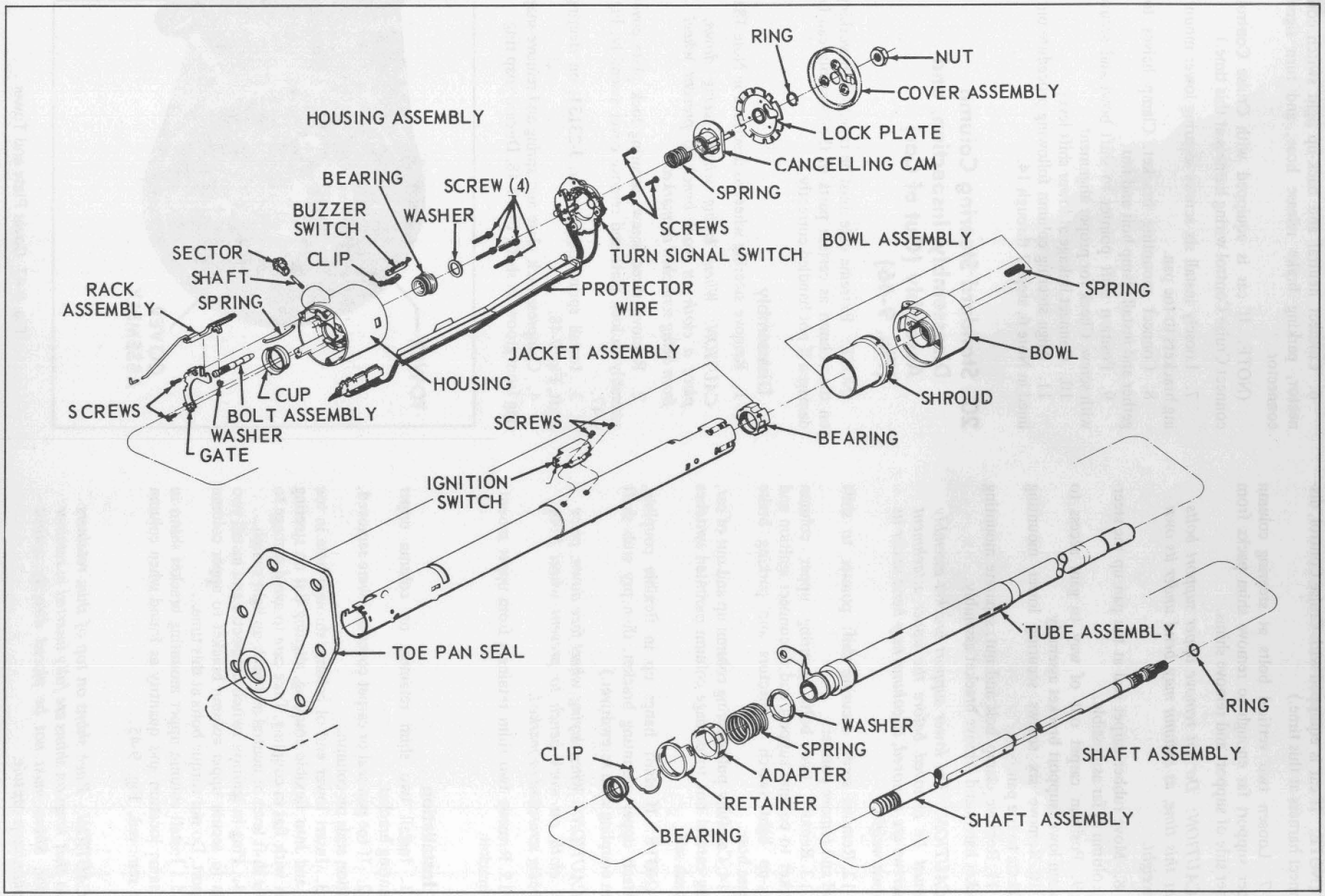


Fig. 9-46 Standard Steering Column Disassembled

(NOTE: If car is equipped with Cruise Control, disconnect harness at this time.)

7. Loosen two vertical bolts at steering column upper support far enough to remove shim packs from either side of support and remove shims.

CAUTION: Do not remove upper support bolts at this time, as column may bend under its own weight.

8. Move rubber carpet seal at toe pan up the steering column as far as possible.
9. Position carpet out of way to gain access to column lower support bracket assembly.
10. Remove six screws securing lower mounting brackets to toe pan.
11. Remove clamp bolt and nut, separate mounting bracket halves and remove bracket assembly.

CAUTION: The lower support bracket assembly must be removed before the upper attachment screws are removed, as column may bend under its own weight.

12. Remove screw securing shift pointer to shift bowl and remove pointer.
13. Remove two bolts securing upper column bracket to column support and disconnect ignition and back-up light switch connectors and parking brake release hose.
14. Carefully pull steering column up and out of car, being careful not to damage column mounted switches or dash seal.

(NOTE: If shaft hangs up in flexible coupling, reattach upper mounting bracket, then pry stub shaft from coupling with screwdriver.)

CAUTION: When laying wheel face down, place a cloth on work bench to prevent wheel from being scratched or marked.

15. Remove two shim retainers from upper mounting bracket.

b. Installation

1. Install two shim retainers on column upper mounting bracket.
2. If toe pan seal or carpet cover seal were removed, position seals on column.
3. Insert lower end of column through hole in toe pan and into flexible coupling, aligning flat on steering shaft with flat in coupling. Take care to avoid damage to lower shift lever or neutral and back-up light switch.
4. Plug in ignition switch connector and install two bolts to secure upper column bracket to upper column support. Do not torque bolts at this time.
5. Install column upper mounting bracket shims in the same location and quantity as found when column was removed, Fig. 9-45.

CAUTION: Place shims on top of shim retainers so that tangs on shims are fully inserted in retainer slot. Shims must not be placed directly against aluminum capsule.

6. Connect neutral and back-up light switch connector, parking brake release hose, and turn signal connector.

(NOTE: If car is equipped with Cruise Control, connect Cruise Control wiring harness at this time.)

7. Loosely install six screws securing lower mounting brackets to toe pan.
8. Connect mounting bracket. Clamp halves together and install clamp bolt and nut.
9. Position shift pointer to shift bowl and secure with screw. Check for proper alignment.
10. Connect linkage at lower shift lever.
11. Align steering column following procedure outlined in Note 6, steps 7 through 14.

20. Standard Steering Column Disassembly, Inspection, and Assembly (Out of Car) (Fig. 9-46)

(NOTE: Extreme care must be taken when working on the column as certain parts of the assembly can be damaged if not handled correctly.)

a. Disassembly

1. Remove steering wheel as described in Note 18a.

CAUTION: When laying wheel facing down, place a cloth on work bench to prevent wheel from being scratched or marked.

2. Remove three screws securing lock plate cover assembly to lock plate and remove cover assembly, Fig. 9-47.
3. Install spring Compressor, J-23131, on steering shaft, Fig. 9-48.
4. Compress lock plate and spring and remove snap ring from groove in shaft, Fig. 9-48. Discard snap ring.

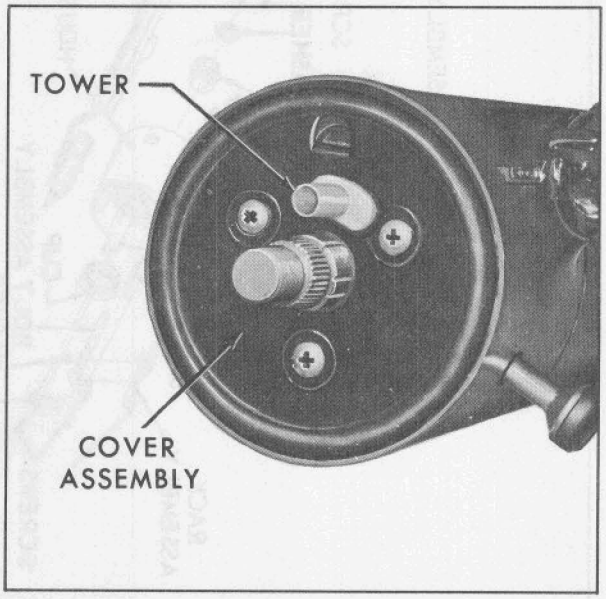


Fig. 9-47 Cover Plate and Tower

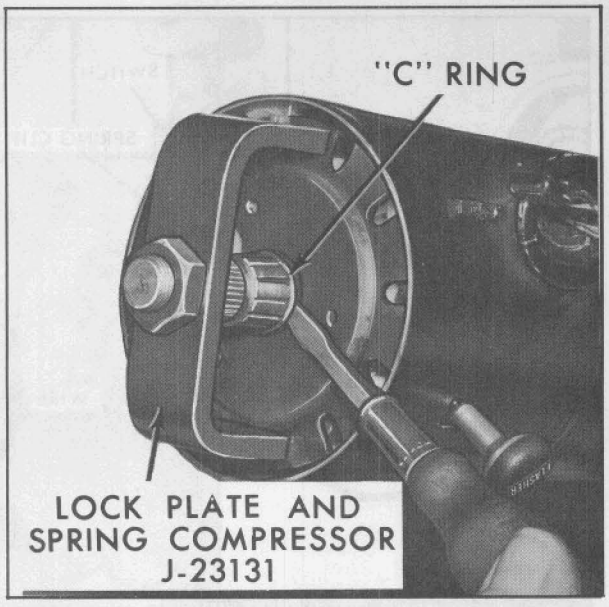


Fig. 9-48 Removing and Installing C-Ring (Standard)

CAUTION: The shaft could slide out bottom of column when snap ring is removed, causing damage to shaft.

5. Remove lock plate by sliding plate up and off upper shaft.

6. Slide turn signal cancelling cam and upper bearing preload spring off upper steering shaft.

7. Slide thrust washer off upper steering shaft.

CAUTION: Care should be taken at this point. Steering shaft is free and could slide out of the column.

8. Push hazard warning switch in, unscrew knob, and remove knob from column.

9. Remove turn signal lever screw and remove turn signal lever.

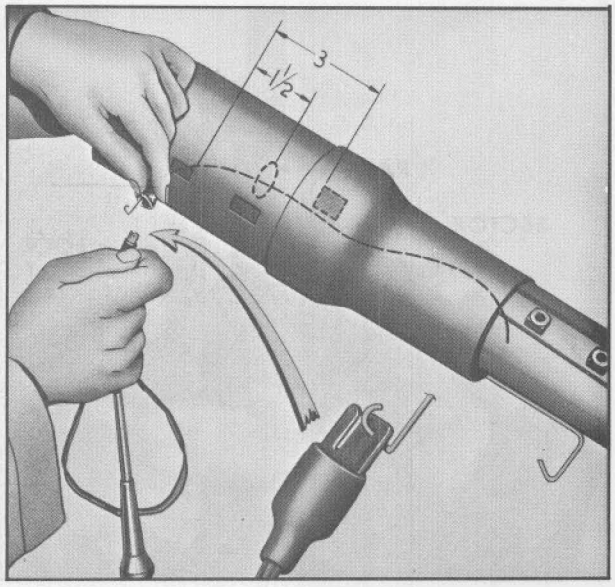


Fig. 9-49 Removing Cruise Control Harness

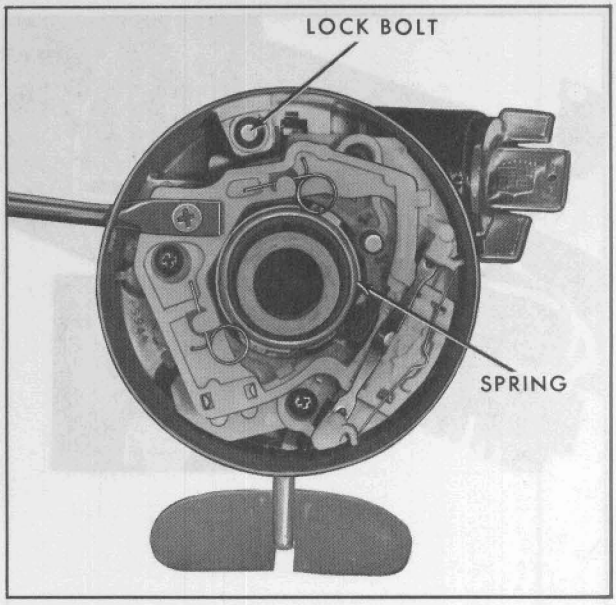


Fig. 9-50 Turn Signal Switch

(NOTE: If car being worked on is equipped with Cruise Control, perform the following procedure.)

a. Attach a long piece of piano wire to connector on Cruise Control switch harness, Fig. 9-49.

b. Using extreme care, gently pull Cruise Control harness up through and out of column.

c. Remove piano wire from harness connector and secure lower end of piano wire to steering column.

(NOTE: Piano wire must be used so that Cruise Control harness can be guided through the proper passages on installation. Disassemble column by sliding internal components over wire, to permit location of passages for reassembly.)

10. Remove three turn signal switch mounting screws, Fig. 9-50.

11. Slide turn signal switch connector out of bracket on steering column jacket.

12. Wrap a piece of tape around the turn signal switch connector and harness, Fig. 9-51, to facilitate removal.

13. Remove four bolts that secure upper mounting bracket to steering column and remove bracket.

14. Free turn signal switch wiring protector from bracket mounting bosses on upper column jacket.

15. Pull turn signal switch straight up with wire protector attached and remove switch, switch harness, and connector from column, Fig. 9-51.

16. Turn ignition switch to the On or Run position.

17. Insert a small, thin screwdriver into slot next to the switch mounting screw boss, Fig. 9-52. Depress lock cylinder retaining tab with screwdriver and remove lock cylinder.

18. Using a piece of stiff wire (such as a paper clip) hook wire in exposed loop of buzzer switch wedge spring, Fig. 9-53. Pull straight out on spring and remove switch and wedge spring.

CAUTION: If wedge spring is dropped on re-



Fig. 9-51 Taping Connector

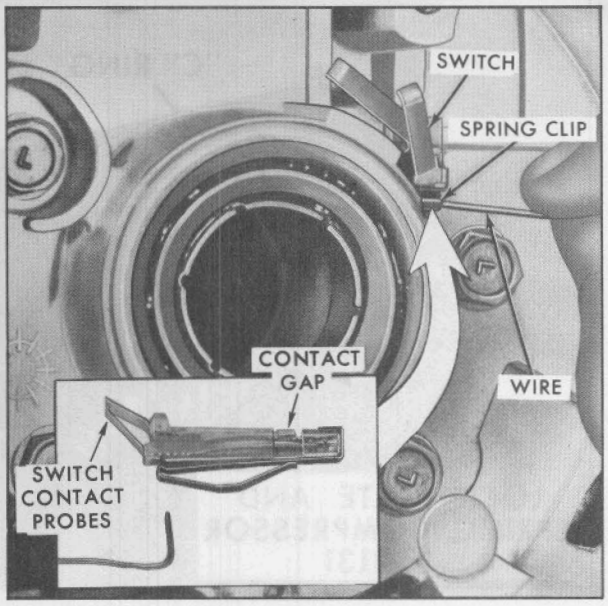


Fig. 9-53 Removing Buzzer Switch

moval, spring could become lost in column, requiring complete disassembly of column.

19. Pull actuator rod as far as possible, then move rod back two detents.

20. Remove two screws securing ignition switch to lower steering column jacket. Slide switch off actuator rod and remove switch from column.

21. Support upper end of steering column and drive out shift lever pivot pin. Remove shaft lever.

b. Upper Housing Disassembly (Fig. 9-46) (On Bench)

1. Place shift bowl in Park position.
2. Remove four screws securing upper housing assembly to steering column jacket and remove housing assembly.
3. Remove thrust cup from housing.
4. Remove rack and lock bolt, Fig. 9-54.
5. Remove load spring from housing, and remove shift gate.
6. Remove sector through lock cylinder hole by pushing firmly on block tooth with a blunt punch, Fig. 9-55.

c. Shift Bowl and Shift Tube Disassembly

These parts are not to be removed from outer jacket. Where servicing is required, replace with complete shift bowl, shift tube, and outer jacket assembly.

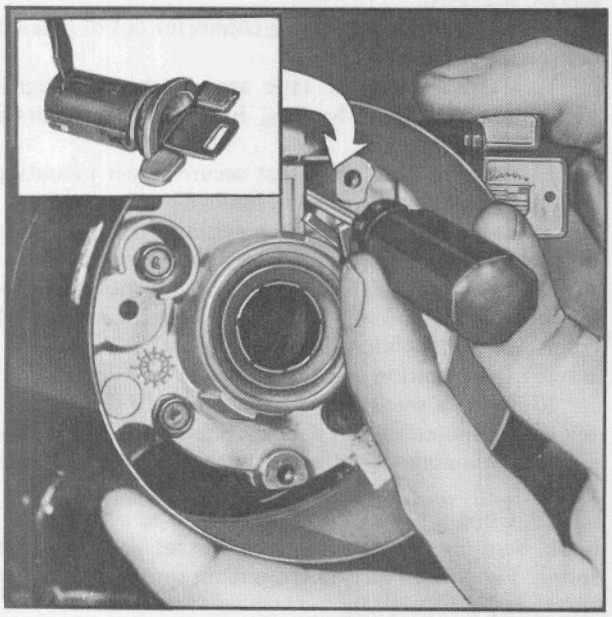


Fig. 9-52 Removing Lock Cylinder

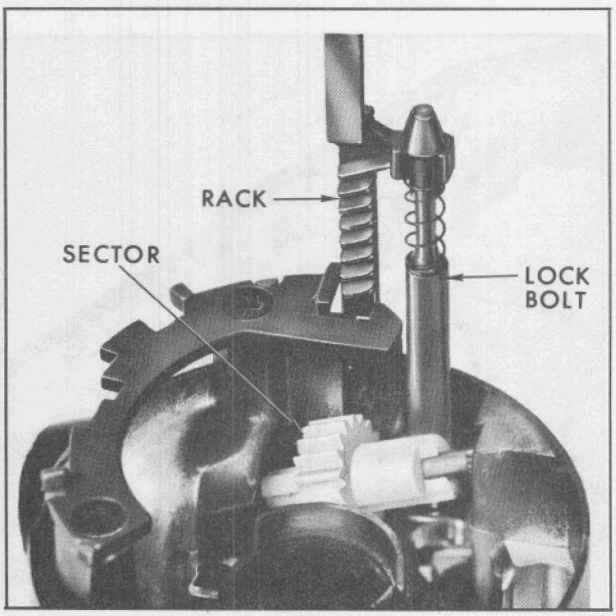


Fig. 9-54 Removing Rack and Lock Bolt

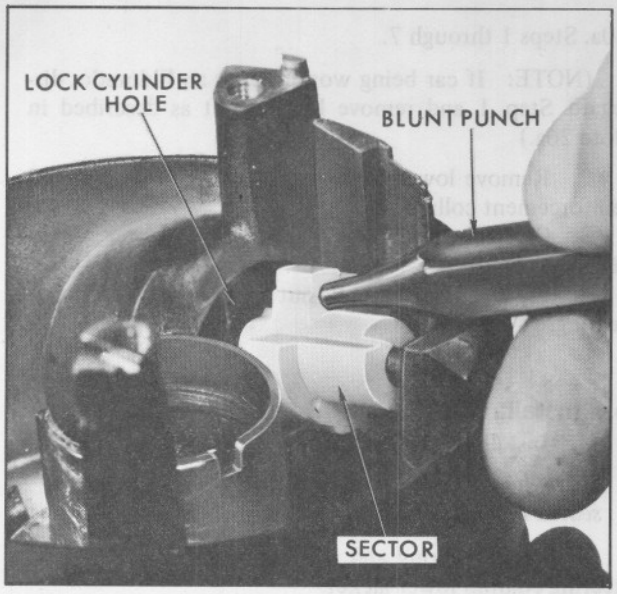


Fig. 9-55 Removing Sector

d. Steering Shaft Removal (On Bench)

1. Using a screwdriver, remove lower bearing adapter retaining clip.
2. Slide lower bearing reinforcement collar, bearing adapter and bearing, shift tube spring, and washer off shift tube and out of jacket.

(NOTE: Bearing may be removed from adapter by a light pressing operation on the outer race.)

3. Remove steering shaft from lower end of column.

e. Steering Shaft Installation (On Bench)

1. Install washer, shift tube spring, bearing adapter with bearing installed, and reinforcement collar onto lower end of column.
2. Hold bearing adapter and reinforcement collar in position and install retaining clip in slots in steering column jacket.
3. Slide steering shaft up into column from lower end.

CAUTION: Take care not to hit the drive tab on the neutral and back-up switch assembly when sliding shaft up through column.

f. Upper Housing Assembly (Fig. 9-45) (On Bench)

(NOTE: Apply a thin coat of lithium grease or equivalent to all friction surfaces. If column is equipped with Cruise Control, assemble parts over piano wire used for disassembly to assure proper installation of Cruise Control harness.)

1. Install sector onto support shaft through lock cylinder hole with drive tang end of sector facing out. Press the sector onto shaft with a blunt punch.
2. Install shift gate in housing.
3. Insert rack spring in housing from bottom side.
4. Assemble bolt to cross-over arm of rack, Fig. 9-56.

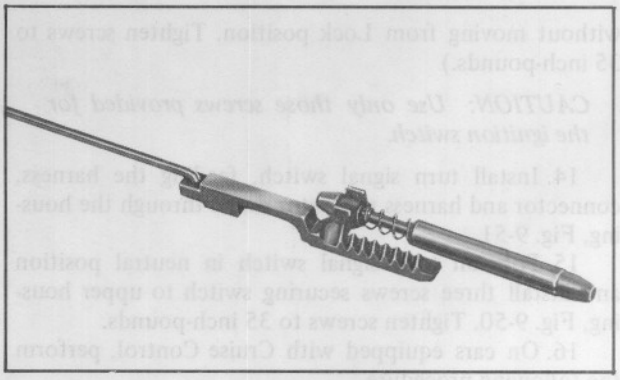


Fig. 9-56 Assembling Lock Bolt and Rack

5. Install rack and lock bolt assembly into the housing from the lower end of housing, with teeth up and toward centerline of column. Make sure wide tooth on sector aligns with wide gap at bottom end of rack.
6. Install thrust cup on bottom hub of housing.
7. Install ignition switch actuator rod through shift bowl and position housing on shift bowl. Secure housing to outer jacket with four screws. Torque to 60 inch-pounds.
8. Position wedge spring on buzzer switch with formed end of clip around the lower end of switch making the spring bow away from the switch.
9. Push switch and spring into hole in housing with switch contacts pointing toward the center of the column and up.
10. Hold lock cylinder sleeve and rotate key clockwise against stop when viewed from key end. Make sure buzzer switch drive tang is below O.D. of lock cylinder.
11. Insert ignition lock cylinder and sleeve assembly into housing bore with key on cylinder sleeve aligned with keyway in housing. Maintaining a light push inward on cylinder, push until drive section of cylinder touches sector.
12. Rotate key counterclockwise while maintaining inward pressure until lock sector drive engages sector drive. Then, push in until lock cylinder retaining tab pops into groove and lock cylinder is secured in housing. Check freedom of lock cylinder rotation. There must be a free spring return from Start to Run position.

(NOTE: A 1/16" drill shank gage must be inserted between the lock cylinder knob and the column housing to avoid assembling the lock cylinder into the column beyond its normal position.)

13. Assemble ignition switch on actuator rod and adjust to the Lock position.

(NOTE: The Lock position can be found by holding the switch actuating rod stationary with one hand, then moving the switch toward the bottom of the column with the other hand until the end of travel in the switch has been reached. This is the Accessory position. Next back off one detent in the switch and this will be the Lock position. Make sure the ignition key is in the Lock position, then assemble the ignition switch to the column using the two screws provided. Take care to assure proper engagement of drive rod and switch slider

without moving from Lock position. Tighten screws to 35 inch-pounds.)

CAUTION: Use only those screws provided for the ignition switch.

14. Install turn signal switch, feeding the harness, connector and harness protector down through the housing, Fig. 9-51.

15. Position turn signal switch in neutral position and install three screws securing switch to upper housing, Fig. 9-50. Tighten screws to 35 inch-pounds.

16. On cars equipped with Cruise Control, perform the following procedure.

a. Connect Cruise Control harness connector to piano wire used on removal, Fig. 9-49.

b. Feed Cruise Control harness into turn signal lever opening in steering column housing assembly. Next, gently pull on piano wire and pull Cruise Control harness through the steering column and into position.

c. Remove tape from harness.

d. Remove piano wire from harness connector.

e. Position turn signal lever on turn signal switch and secure lever to turn signal switch with one screw. Tighten screw to 35 inch-pounds.

17. Position turn signal switch wiring protector over upper bracket mounting bosses on upper steering column.

18. Position steering column upper mounting bracket over turn signal wiring harness protector and secure bracket to column with four screws. Tighten screws to 20 foot-pounds.

19. Install turn signal switch connector in bracket on steering column upper jacket.

20. Install hazard warning switch knob.

21. Position turn signal lever on switch and install one screw securing lever to turn signal switch. Make sure switch is in neutral position.

22. Install thrust washer on Steering shaft.

23. Install upper bearing preload spring and turn signal cancelling cam.

24. Install lock plate with large flat on plate aligned with large flat on steering shaft.

25. Place a new snap ring on upper end of steering shaft.

CAUTION: Do not use old snap ring because ring becomes distorted upon removal.

26. Install Spring Compressor, J-23131, on steering shaft, Fig. 9-48.

27. Compress lock plate and spring. Next slide new snap ring down shaft until ring locks in groove in upper end of shaft. Remove spring compressor tool.

28. Position cover assembly on upper end of column and install three screws securing cover to lock plate.

29. Install steering wheel as described in Note 18b.

30. Install steering column into car as outlined in Note 19b.

21. Steering Column Lower Bearing Removal

a. Removal

1. Remove steering gear from car, following Note 10a, Steps 1 through 7.

(NOTE: If car being worked on is an Eldorado, disregard Step 1 and remove lower shaft as described in Note 26a.)

2. Remove lower bearing adapter retaining clip and reinforcement collar.

3. Carefully pry lower bearing and adapter assembly from shaft.

4. Pry bearing assembly out of adapter and discard bearing.

b. Installation

1. Install new lower bearing into bearing adapter.

CAUTION: Make certain that bearing is properly seated in adapter.

2. Install bearing and adapter on shaft and up into steering column lower jacket.

3. Install reinforcing collar over end of jacket.

4. Install retaining clip that holds adapter and collar to jacket.

5. Install steering gear as described in Note 10b, Steps 1 through 6.

(NOTE: If working on an Eldorado, disregard Step 5 and install lower shaft as described in Note 26b.)

22. Steering Shaft

In the event that the two nylon shear pins in the energy-absorbing steering column break due to impact not strong enough to collapse steering column jacket or shift tube, steering shaft must be repaired ONLY in the manner prescribed below.

(NOTE: If jacket or shift tube collapse, column must be replaced as an assembly.)

1. Remove steering column from car as outlined in Note 19a.

2. Remove steering shaft from column as described in Note 20d for standard column or Note 24b for Tilt and Telescope column.

3. Pull upper solid shaft out of lower tube shaft approximately 3/8" or until a stop is felt. Plastic will be just visible.

(NOTE: It should not be necessary to repair the lower plastic joint in a two-joint shaft.)

4. Obtain a steering shaft repair kit. Kit consists of three snap rings and a supply of special primer and adhesive. Materials in kit are sufficient to service three cars.

5. Wipe shaft clean and dry for about one inch from tube.

6. Spray this area liberally with special primer. Allow not more than 20 minutes to dry.

7. Spread a 3/8" wide strip of special adhesive around primed area of shaft, and push shaft together until proper overall length is obtained.

STEERING SHAFT LENGTHS

	Standard Column	Tilt and Telescope Column
All Except Eldorado	36-31/32	30-13/32
Eldorado	37- 1/16	30-17/32

Allow joint to set up at least five minutes, then wipe off excess adhesive. Adhesive will harden to 350 lbs. yield strength.

(NOTE: If working on Eldorado lower shaft, spread adhesive to a 1"-2" width to obtain 1,000 lb. yield strength.)

8. Install shaft into column using a new snap ring, as outlined in Note 20e for standard column or Note 24h for Tilt and Telescope column.
9. Install column in car, Note 19b.

23. Lock Cylinder Service

a. Lock Cylinder Tumbler

The 1972 lock cylinder has a push-to-accessory feature. This feature will not allow the lock cylinder to go from the Lock to the Accessory position, unless the cylinder is pushed in toward steering column.

New lock cylinder assemblies, Fig. 9-57, for duplicating ignition locks are available from parts distribution centers, with the locking bar staked in place. Tumblers are also available, but must be assembled into the cylinder according to a special code.

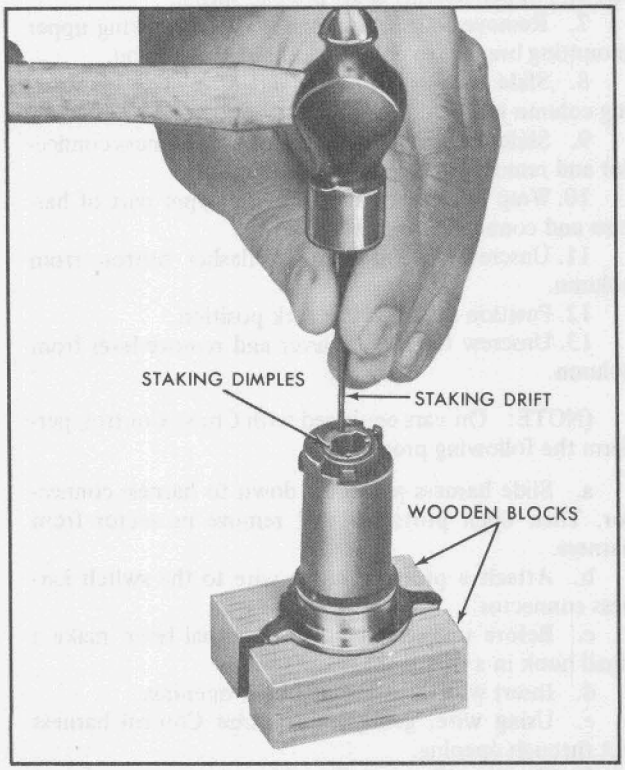


Fig. 9-57 Lock Cylinder

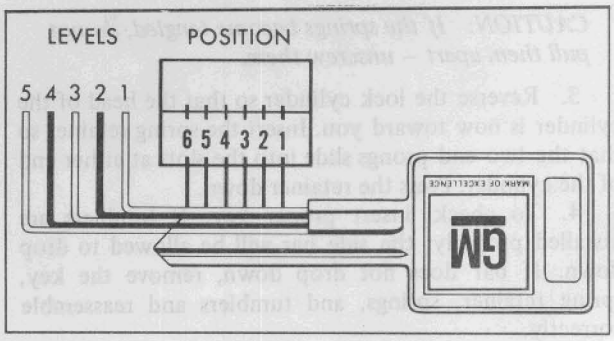


Fig. 9-58 Key Code Diagram

When it is necessary to assemble a new lock cylinder to agree with a key code number, install the proper tumblers into their respective slots as indicated by Key Code Diagram, Fig. 9-58, or a code list.

Tumblers of all ignition locks are shaped exactly alike, with the exception of the position of a notch on one side. As the key is inserted in the lock cylinder, the tumblers are raised to the correct height so that the notches on each tumbler are on the same level. When the notches on all six tumblers line up, the locking bar is pushed into the notches by two small springs, allowing the cylinder to turn in its bore. Five types of tumblers are used to make all the various lock tumbler combinations and each is coded according to a number 1 through 5, stamped on its side. Refer to Part c to assemble all lock cylinders.

To determine which tumblers should be installed in what position for a given key, when a code list is not available, proceed as follows:

1. Lay the key on the Key Code Diagram, Fig. 9-58, with the key outlined by the diagram as accurately as possible.
2. Starting at the base of the key blade, determine the lowest level that is visible in position #1.
3. Determine the lowest visible level for the remaining five positions. As each tumbler level is determined, write the number in the blank space provided above the position numbers.
4. Cuts that fall in the first white section, mark level #1 on top of appropriate position number.
5. Cuts that fall in the first black section, mark #2 on top of appropriate position number.
6. Cuts that fall in the second white section, mark #3 on top of appropriate position number.
7. Cuts that fall in the second black section, mark #4 on top of appropriate position number.
8. Cuts that fall in the third white section, mark #5 on top of appropriate position number.

b. Coding Lock Cylinder

After the tumbler arrangement has been determined as shown in Part a, ignition and door lock cylinders should be assembled as follows:

1. Hold cylinder with head of cylinder away and, starting at the head of the cylinder, insert the tumblers in their proper slots in the order called for by the code ribbed side toward you and long point down.
2. Insert one tumbler spring in the space provided above each tumbler.

CAUTION: If the springs become tangled, do not pull them apart – unscrew them.

3. Reverse the lock cylinder so that the head of the cylinder is now toward you. Insert the spring retainer so that the two end prongs slide into the slots at either end of the cylinder. Press the retainer down.

4. To check, insert proper key. If tumblers are installed properly, the side bar will be allowed to drop down. If bar does not drop down, remove the key, spring retainer, springs, and tumblers and reassemble correctly.

(NOTE: If the tumblers have not been assembled correctly, they can be removed from the cylinder by holding it with the tumbler slots down, pulling the locking bar out with the fingers and jarring the cylinder to shake the tumblers out. This procedure is necessary because once the tumblers have been pressed down into the cylinder, they are held in their slots by the locking bar.)

5. If, after checking, the lock is found to be assembled properly, remove key and secure cylinder in a vise with spring retainer exposed. Use leather or wood to cover each vise jaw to prevent damage to the cylinder.

6. Stake the retainer securely in place by staking the cylinder metal over both edges at each retainer end, using a suitable staking tool at right angles to the top of the retainer.

c. Reassembling Lock Cylinder

1. Install wave washer, then armor washer (tang facing up) on lock cylinder. Position case over cylinder with tang of armor washer in line with its side bar slot in case.

2. Hold case with buzzer pin (white plastic tip) facing up. Using left index finger, hold pin in fully extended (up) position.

3. Slide cylinder into case, with washer tang going into case slot, until spring pressure is felt.

4. Insert key into lock cylinder and push cylinder rest of way into case.

5. To secure cylinder in case, place finger tabs and key between two blocks of wood allowing face of cylinder to rest on blocks, Fig. 9-57.

6. Place retaining ring on end of cylinder and tap ring lightly down to shoulder on cylinder.

(NOTE: Retaining ring must be installed with ring tab face toward front of cylinder.)

7. Rotate lock cylinder from Accessory through Start position and back, to assure assembly is correct and movement is free.

8. Using a small flat drift at least 1/8" in diameter, stake lock cylinder over retaining ring in four dimpled places, as shown in Fig. 9-57.

CAUTION: Whenever additional keys are required, always use original equipment key blanks which are made of special locksmith brass. The use of steel or aluminum key blanks can cause excessive lock wear or insufficient key section strength.

24. Tilt and Telescope Column Disassembly, Inspection, and Assembly (Out of Car) (Fig. 9-59)

(NOTE: Extreme care must be taken when working on the column as certain parts of the assembly may be damaged if handled incorrectly.)

a. Disassembly

1. Remove steering wheel as described in Note 18a.

CAUTION: When laying wheel face down, place a cloth on work bench to avoid scratches or marks on steering wheel.

2. Slide rubber sleeve bumper from steering shaft.

(NOTE: Save rubber sleeve bumper as it must be reinstalled at column assembly. If distorted, it should be replaced with a new bumper.)

3. Remove plastic retainer, using small screwdriver to disengage tabs on retainer from C-ring.

4. Install Spring Compressor, J-22063, on steering shaft, Fig. 9-60, threading bolt into steering shaft lock hole.

(NOTE: When installing spring compressor, pull upper shaft up 1" from bottomed position, then turn ignition to Lock to hold shaft in place.)

5. Compress upper steering shaft preload spring and remove C-ring, Fig. 9-60.

6. Remove Spring Compressor, J-22063, and remove upper steering shaft lock plate, horn contact carrier and upper steering shaft preload spring.

7. Remove four screws and washers securing upper mounting bracket to column and remove bracket.

8. Slide harness connector out of bracket on steering column jacket.

9. Slide harness protector down to harness connector and remove protector from column.

10. Wrap a piece of tape around upper part of harness and connector, Fig. 9-51.

11. Unscrew hazard warning flasher button from column.

12. Position shift bowl in park position.

13. Unscrew turn signal lever and remove lever from column.

(NOTE: On cars equipped with Cruise Control, perform the following procedure:)

a. Slide harness protector down to harness connector. Then open protector and remove protector from harness.

b. Attach a piece of piano wire to the switch harness connector.

c. Before unscrewing the turn signal lever, make a small hook in a thin piece of stiff wire.

d. Insert wire in turn signal lever opening.

e. Using wire, gently pull Cruise Control harness out through opening.

f. Gently pull remainder of harness up through and out of column.

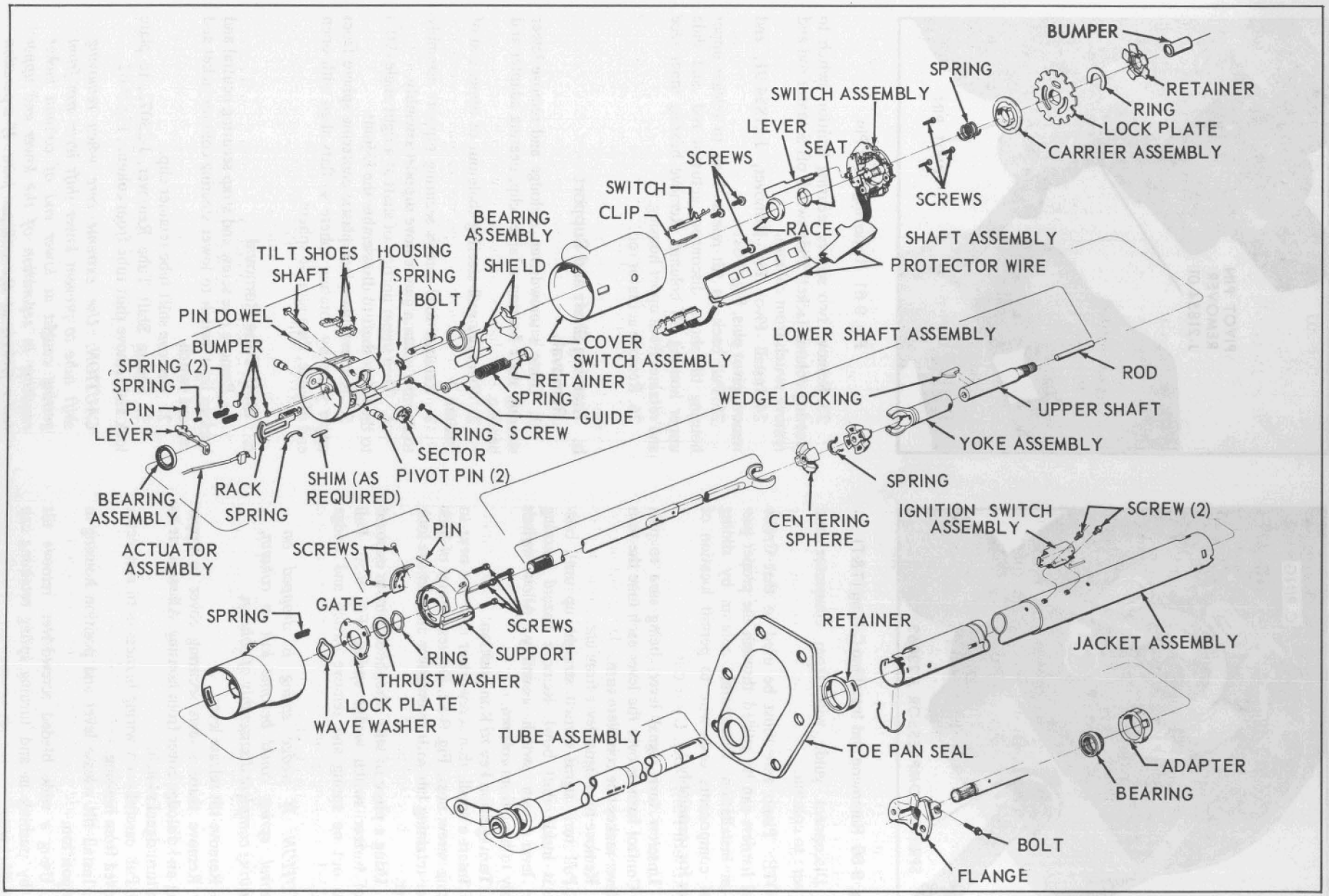


Fig. 9-59 Tilt and Telescope Steering Column Disassembled

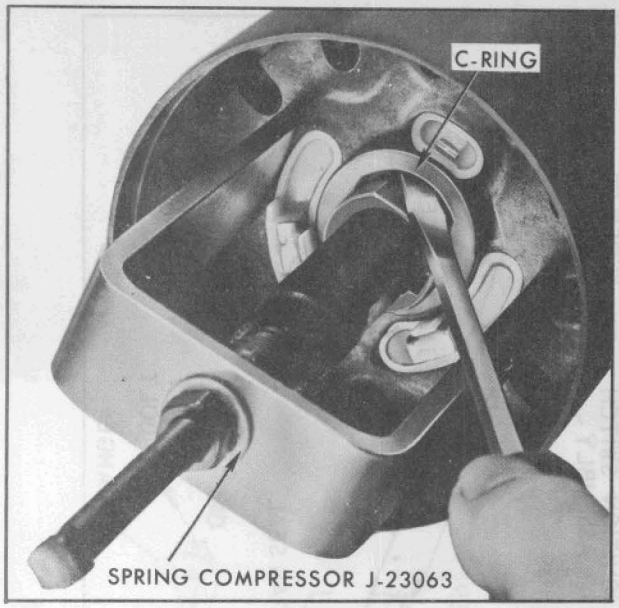


Fig. 9-60 Removing and Installing C-Ring (T&T)

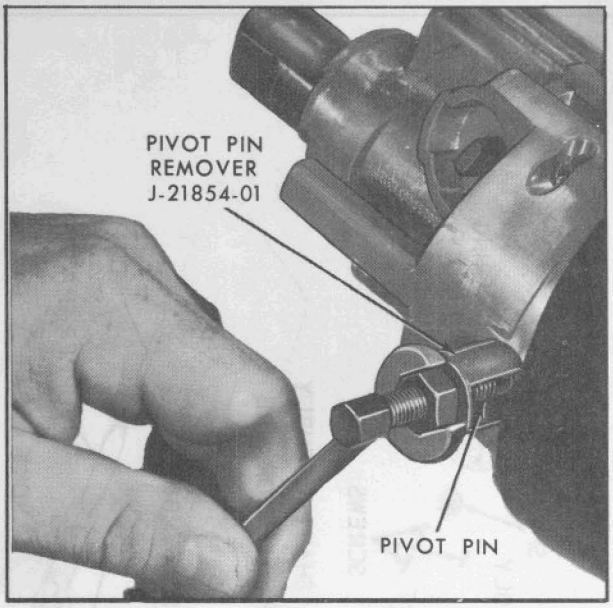


Fig. 9-61 Removing Pivot Pin

g. Disconnect guide wire from connector and secure wire to column.

(NOTE: Piano wire must be used so that Cruise Control harness can be guided through the proper passages on installation. Disassemble column by sliding internal components over wire to permit location of passages for reassembly.)

h. Unscrew turn signal lever, being sure to pass Cruise Control harness over the lever each time the turn signal lever makes one complete turn.

i. Remove turn signal lever from car.

14. Pull turn signal switch straight up until connector is inside shift bowl. Remove hazard warning flasher lever from switch assembly. Allow switch assembly to hang from column.

15. Turn ignition key to Run position.

16. Insert a small, thin screwdriver into slot next to mounting screw boss, Fig. 9-52. Depress center of lock cylinder retaining tab with screwdriver and remove lock cylinder.

17. Using a piece of stiff wire, hook wire in exposed loop of buzzer switch wedge spring, Fig. 9-53. Pull straight out on spring and remove switch and wedge spring.

CAUTION: If wedge spring is dropped on removal, spring could become lost in column, requiring complete disassembly of column.

18. Remove tilt release lever.

19. Remove three screws securing cover to upper housing and dislodge cover from housing. Allow cover to rest on turn signal switch.

20. Pull carefully on wiring harness until connector is removed from housing.

21. Install tilt release lever and position housing in full up position.

22. Using a wide bladed screwdriver, remove tilt spring by pushing in and turning spring retaining cap counterclockwise.

23. Remove two screws securing ignition switch to steering column jacket. Slide switch off actuator rod and remove switch from column.

24. Install Pivot Pin Remover, J-21854-01, and remove pivot pins, Fig. 9-61.

25. Pull back on tilt release lever to release upper housing tilt shoes, disconnect actuator rod, and slide upper housing off column. Remove bearing inner race and retainer from upper housing.

26. Remove actuator rod.

b. Steering Shaft and Support Removal

1. Using a screwdriver, dislodge and remove lower steering shaft bearing retainer clip, bearing adapter and bearing.

2. Carefully pull steering shaft out of upper end of column.

3. Remove four screws securing support assembly to steering column and remove support assembly.

4. Turn upper portion of shaft at a right angle (90°) to the lower shaft to disassemble the U-joint.

5. Remove two-piece plastic centering sphere from upper yoke by rotating sphere so flats align with open end of yoke, then remove sphere.

c. Shift Tube Removal

1. Remove one screw and strap securing neutral and backup light switch to lower steering column jacket and remove switch.

2. Remove shift tube retainer clip.

3. Secure Shift Tube Remover, J-23072, to plate lock and remove shift tube from column, Fig. 9-62.

CAUTION: Use extreme care when removing shift tube to prevent lower shift lever arm from getting caught at lower end of column jacket resulting in separation of the lower and upper outer jackets at the collapse joint. If separation

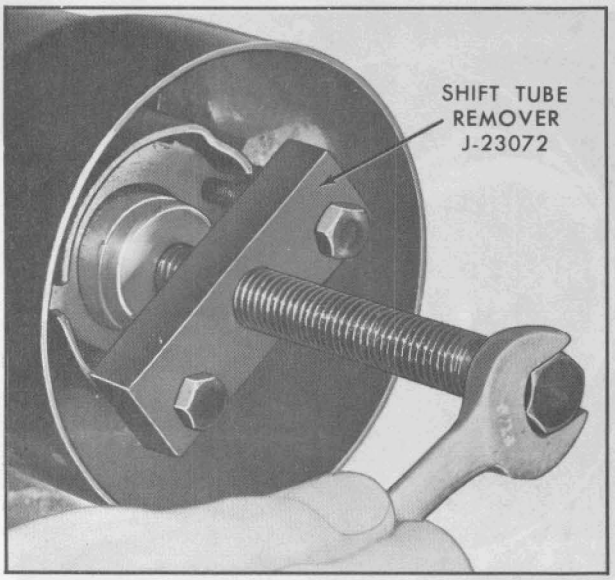


Fig. 9-62 Removing Shift Tube

occurs, a new outer jacket assembly will be required.

4. Remove thrust washer, plate lock, and wave washer and remove shift bowl.

d. Upper Housing Disassembly

1. Remove tilt lever and opening shield and turn signal lever and opening shield from housing, Fig. 9-63.
2. Remove lock bolt spring by removing spring retaining screw. Then, turn spring clockwise and remove spring from bolt.



Fig. 9-63 Lever Opening Shields

3. Remove snap ring from sector drive shaft. Using a small punch, lightly tap drive shaft out of sector.
4. Remove drive shaft, sector and lock bolt.
5. Remove rack and rack spring.
6. Wedge shoes inward with a block between top of the shoes, and bearing housing. Using Pin Remover, J-22635, through slot in opposite side of housing, with flat on tool over shoulder next to pin, drive release lever pin out of bearing housing, Fig. 9-64. Remove Pin Remover, J-22635, and remove release lever and spring.
7. Using Pin Remover, J-22635, drive out lock shoe pin. Carefully remove pin remover and remove lock shoes and springs.

(NOTE: With tilt lever opening on left side and shoes facing up, the four slot shoe is on the left.)

e. Inspection

1. Inspect all bearings for wear, roughness and binding. Replace as required.
2. Inspect centering sphere for nicks, damage, and wear. If damage is evident, replace centering sphere.
3. Inspect bearing surfaces of upper shaft for brinelling, nicks, scratches, and wear.
4. Inspect rubber bumpers, making certain they are not torn or damaged.
5. Inspect telescoping mechanism for wear in keyway.
6. Inspect all threads and splines for damage.
7. Inspect locking rod for straightness.
8. Inspect shift bowl for cracks.
9. Inspect steering shaft, shift tube, and outer jacket for signs of damage.

(NOTE: If collapse joint between upper and lower jacket shows movement or is loose, the outer jacket assembly must be replaced.)

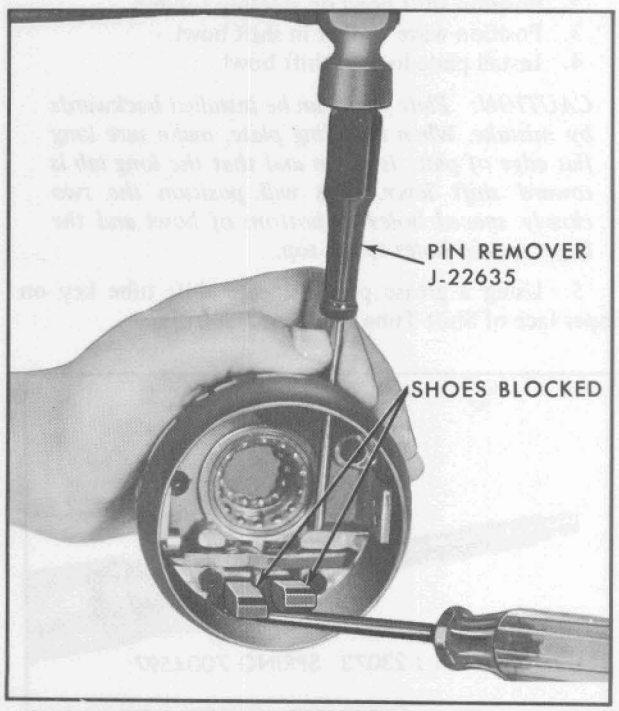


Fig. 9-64 Removing Release Mechanism

10. Inspect all other parts for damage and wear. Replace if necessary.

f. Upper Housing Assembly

1. Apply a thin coat of lithium base (spherical joint) grease or equivalent to all friction parts.
2. Using Pin Remover, J-22635, to line up shoes, install lock shoe springs and lock shoes in upper housing and retain with pin.

(NOTE: With tilt lever opening in housing on left side, and shoes facing up, the four slot shoe is on the left.)

3. Wedge shoes inward with a block between top of shoes and bearing housing. Install spring, release lever, and pin in bearing housing. Remove block from shoes.
4. Install drive shaft in housing, then lightly tap sector onto the shaft far enough to install snap ring. Install snap ring.
5. Install lock bolt and engage sector cam surface.
6. Install rack spring and rack.

(NOTE: Block tooth on rack must engage block tooth on sector.)

7. Install lock bolt spring with "U" shaped arm of spring in the large cavity of the sector and the single wire arm attached to the lock bolt. Install spring retaining screw and tighten to 35 inch-pounds.
8. If removed, install shift lever spring in bowl by winding spring up with pliers and pushing in.
9. Install tilt lever opening shield and turn signal lever opening shield into housing, Fig. 9-63.

g. Shift Tube Installation (On Bench)

1. Install part of Shift Tube Installer, J-23073, in shift tube, Fig. 9-65.
2. Position shift bowl on steering column.
3. Position wave washer in shift bowl.
4. Install plate lock in shift bowl.

CAUTION: Plate lock can be installed backwards by mistake. When installing plate, make sure long flat edge of plate is down and that the long tab is toward shift lever. This will position the two closely spaced holes to bottom of bowl and the larger spaced holes to the top.

5. Using a grease pencil, locate shift tube key on upper face of Shift Tube Installer, J-23073.

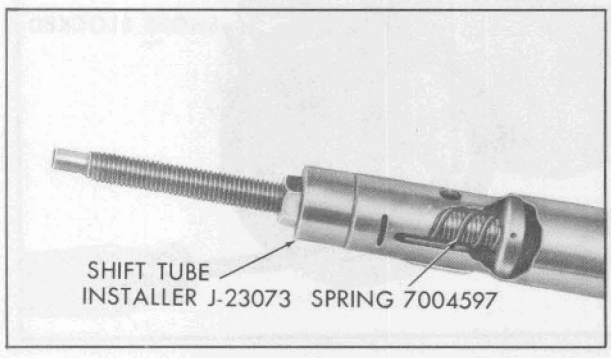


Fig. 9-65 Installing Shift Tube Installer

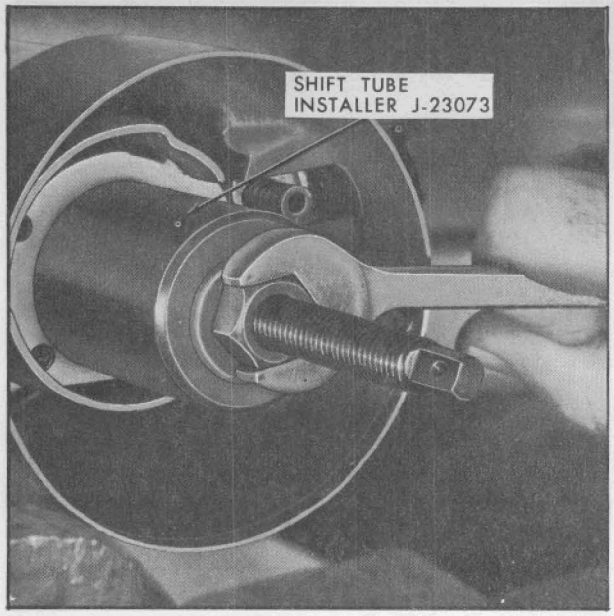


Fig. 9-66 Installing Shift Tube

6. Slide shift tube up and into column from lower end of column aligning with keyway in shift bowl.
7. Using alignment marks on Shift Tube Installer, J-23073, align shift tube key with keyway in shift bowl and install remainint parts of Shift Tube Installer, J-23073, Fig. 9-66.
8. Tighten nut on Shift Tube Installer, J-23073, and install shift tube, Fig. 9-66.

CAUTION: When installing shift tube, make sure transmission linkage lever on lower end of tube is centered in slot in lower end of steering column jacket.

9. Remove Shift Tube Installer, J-23073.
10. Install thrust washer on upper end of shift tube.
11. Install snap ring on upper end of shift tube. Snap ring is installed when notches are engaged.

h. Steering Shaft and Support Assembly - Installation

1. Install support assembly by aligning "V" in support with "V" notch in jacket and install four screws securing support assembly to plate lock. Tighten screws to 60 inch-pounds. *See CAUTION on Page 9-21.*
2. Install sphere in upper yoke.

CAUTION: Make sure lash take-up spring (horseshoe in shape) is properly positioned between spheres before assembling to upper yoke.

3. Rotate centering sphere so that lower steering shaft can be installed over flats on sphere (approximately 90° from center line of upper portion of shaft.) Then install lower shaft coupling over the sphere. Looking along shaft from top make sure keyway faces right when flat on lower shaft splines is facing up. If parts are mispositioned, turn signals will not cancel after turn signal is used for lane changing.
4. Install steering shaft in upper end of column.

CAUTION: If neutral and back-up switch was not removed, be careful not to hit switch drive tang with end of shaft as breakage may result.

5. Install bearing and bearing adapter in lower end of steering column jacket.

6. Install cup over lower end of steering column jacket and install lower steering shaft bearing retainer clip.

i. Housing Cover, Lock Cylinder, Ignition Switch and Neutral and Back-Up Light Switch - Assembly

1. Pull up on tilt lever and install upper housing assembly with lock bolt toward top.

2. Install actuator rod in rack in housing assembly.

3. Guide actuator rod through shift bowl while positioning housing assembly on support assembly. Extend rack as far as possible and engage actuator rod.

4. Pull back on tilt lever and engage tilt shoes in support assembly.

5. Align pivot pin holes and install pivot pins by hand, then tap them in with a plastic mallet. The column must be supported to prevent any bending forces on the collapse area.

6. If removed, install upper bearing in housing assembly.

7. Install upper bearing inner race and retainer ring.

8. Tilt housing to full up position.

9. Position tilt spring guide, tilt spring, and spring retainer in housing assembly.

10. Using a large screwdriver, press in on tilt spring retainer, compress spring and rotate retainer clockwise until retainer locks in housing.

11. Remove tilt release lever.

12. Position turn signal wiring harness inside steering column cover and insert harness into housing until connector is through shift bowl.

13. Install cover over housing assembly.

14. Check tilt lever and turn signal lever opening shields for proper alignment.

15. Install three screws securing cover to housing assembly. Tighten screws to 110 inch-pounds.

16. Position wedge spring on buzzer switch with formed end of clip around the lower end of switch making the spring bow away from the switch, Fig. 9-53.

17. Push switch and spring into hole in housing with switch contacts pointing up, making sure that switch is fully installed.

18. Install hazard warning lever in turn signal switch.

19. Finish installing turn signal switch by feeding harness connector through housing, Fig. 9-51.

20. Position turn signal switch in neutral position and install three screws securing switch to upper housing, Fig. 9-50. Tighten screws to 28 inch-pounds.

(NOTE: When properly installed, cancelling springs should be equal distance from steering shaft. If they are not, one turn signal will not cancel when column is reinstalled on car.)

21. Install hazard warning flasher button and check operation.

22. Assemble ignition switch on actuator rod. Check all ignition key positions, and adjust to the Lock position.

23. To install lock, hold lock cylinder sleeve and rotate key clockwise against stop. Make sure buzzer switch drive tang is below O.D. of lock cylinder. Insert cylinder into cover bore with key on cylinder sleeve aligned with keyway in housing until cylinder touches lock sector shaft.

(NOTE: A 1/16" drill shank gage must be inserted between the lock cylinder knob and the column housing to avoid assembling the lock cylinder into the column beyond its normal position.)

24. Maintaining a light push inward on cylinder, rotate cylinder counterclockwise until drive section of cylinder mates with sector drive shaft. Push in until snap ring on lock cylinder pops into groove in housing. Check freedom of rotation of lock cylinder in housing. There must be a free spring return from start to run position.

25. Install turn signal lever.

(NOTE: On cars equipped with Cruise Control, proceed as follows:)

a. Attach guide wire to Cruise Control switch harness connector.

b. Insert harness connector in opening in steering column cover.

c. Gently pull part of harness down through steering column cover part way.

d. Allow turn signal lever to hang free, with approximately 16" of wire out of column. Then rotate turn signal lever in a clockwise direction six times, permitting Cruise Control harness to make six loops.

e. Insert turn signal lever into opening in column.

f. Screw turn signal lever into position, passing the Cruise Control harness over the turn signal lever each time one full turn of the lever is completed.

CAUTION: The harness must be passed over the lever each time the lever makes one complete turn to prevent damaging harness where it enters into the turn signal level. The wire loops will unwind as the lever is screwed in and wires will be straight in the column. Turn lever tight by hand then use a 5/16" wrench to tighten until recess in turn signal lever is facing toward bottom of column.

g. After lever is installed, gently pull remainder of harness through column and into position.

h. Remove guide wire from Cruise Control harness.

i. Install harness protector on harness and slide protector up harness and into position.

j. Connect Cruise Control harness to connector.

26. Attach connector to column.

27. Install upper steering shaft preload spring.

28. Install lock plate and carrier assembly.

(NOTE: When installing lock plate and carrier assembly, make sure flat on lower end of steering shaft is pointing up and that the small plastic tab on the carrier is up or nearest the top of the shift bowl. Flat surface of lock plate must be installed facing down (against turn signal switch.)

29. If upper end of upper shaft hub was removed, replace shaft and wedge at this time.

30. Install Spring Compressor, J-23063, Fig. 9-60. Compress preload spring and lock plate and install C-ring with wide side toward keyway.

31. Remove Spring Compressor, J-23063.

32. Insert plastic retainer on C-ring.

33. Position turn signal switch harness protector over boss on upper steering column.

34. Position steering column upper mounting bracket over turn signal wiring harness protector and secure bracket to column with four screws and washers. Tighten screws to 20 foot-pounds.

35. Remove tape from turn signal switch wiring harness and connector.

36. Connect turn signal harness to connector and install connector in bracket on steering column jacket.

37. Slide rubber sleeve bumper over steering shaft.

38. Install steering wheel as described in Note 18b.

ELDORADO STEERING

The service information that follows pertains only to the Eldorado. All other description, service procedures and recommendations for the Eldorado are the same as those for other cars as given in the first part of this section.

Steering Linkage (693)

The steering linkage on the 693, Fig. 9-67, consists of a pitman arm, idler arm, two tie rod assemblies, a one piece forged steel drag link, and a shock absorber. The pitman arm connects the left side of the drag link to the steering gear and the idler arm connects the right side of the drag link to the frame. The shock absorber connects the drag link to the frame in such a manner as to dampen vibrations in the linkage. The tie rods serve as connecting links between the drag link and the steering knuckles. Tie rod ends should be checked for looseness and damaged seals. Loose tie rod ends must be replaced as a unit. Tie rod seals are replaceable and any damaged seals should be replaced.

25. Steering Gear (693)

a. Removal

1. Disconnect pressure and return lines from gear. Cap or tape line fittings.

2. Raise car.

3. Remove cotter pin and nut at pitman arm.

4. Disconnect pitman arm from drag link using Puller, J-22292, Fig. 9-68.

5. Remove two nuts and lockwashers holding flexible coupling together.

6. Remove three screws that hold steering gear to frame side rail, move steering gear foward and downward out of car.

7. Working on bench, remove pitman shaft nut and lockwasher and remove pitman arm from pitman shaft using Pitman Arm Puller, J-6632.

b. Installation

See CAUTION on Page 9-21 when performing steps 1, 2 and 4.

1. Place pitman arm on pitman shaft and install lockwasher and nut on pitman shaft. Tighten nut to 185 foot-pounds.

2. Position steering gear on car and secure to frame side rail with three screws and flatwashers. Tighten screws to 70 foot-pounds.

3. Install nuts and lockwashers that hold flexible coupling together. Tighten nuts to 20 foot-pounds.

4. Install drag link to pitman arm and secure with nut and cotter pin. Tighten nut to 60 foot-pounds and install cotter pin.

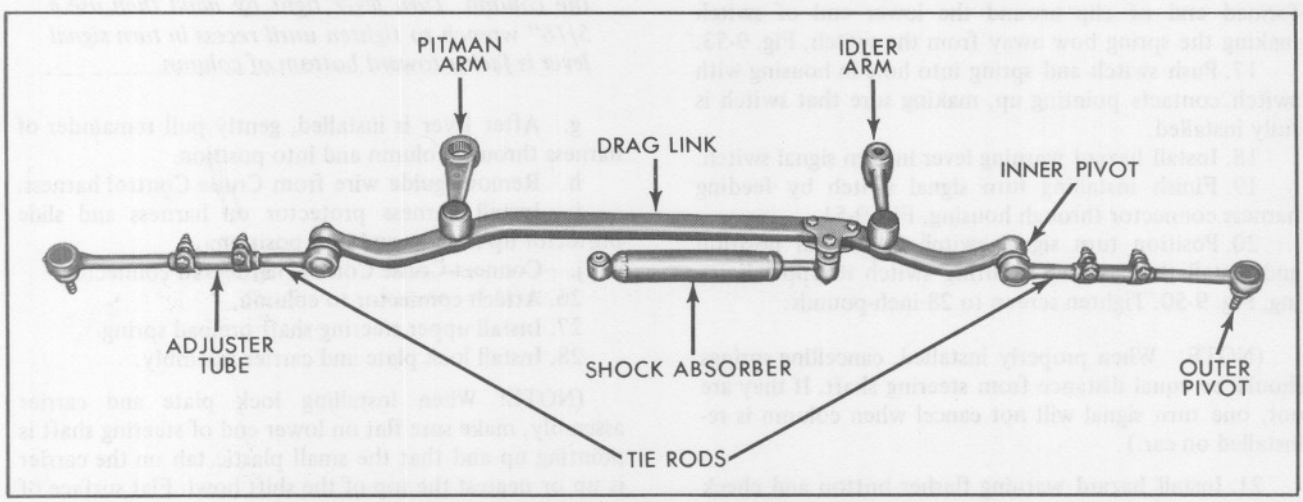


Fig. 9-67 Steering Linkage – 693

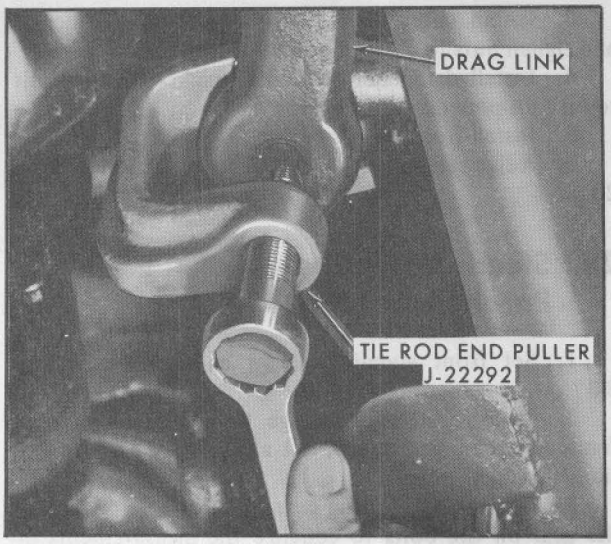


Fig. 9-68 Disconnecting Pitman Arm – 693

(NOTE: If cotter pin cannot be installed, tighten nut to next hole location and install cotter pin.)

5. Uncap pressure and return line hoses and connect to steering gear. Tighten nuts to 30 foot-pounds.
6. Check fluid as outlined in Note 1.

26. Lower Steering Shaft (Fig. 9-69)

a. Removal

1. Remove two nuts and lockwashers and bolts holding flexible coupling together.
2. Remove screw holding flexible coupling to steering gear and shift portion of flexible coupling on gear away from flange on shaft.
3. Disengage flange on shaft from flexible coupling.
4. Remove screw securing universal joint to lower steering shaft and remove shaft from universal joint.

b. Installation

See CAUTION on Page 9-21 when performing steps 1, 2, 5 and 6.

1. Insert lower steering shaft into universal joint aligning split in universal joint with flat on shaft. Secure with screw tightened to 80 foot-pounds.
2. Engage flange on shaft to flexible coupling on gear and secure with two bolts, lockwashers and nuts. Tighten nuts to 20 foot-pounds.
3. Install screw securing flexible coupling to steering gear. There should be at least .040 inch clearance between coupling and adjuster plug. Tighten screw to 30 foot-pounds.

27. Steering Linkage Removal, Disassembly, Assembly, and Installation (693)

a. Removal

1. Remove front wheels.
2. Remove bolt securing steering dampener to bracket on frame.
3. Remove cotter pins and nuts from pitman arm and idler arm pivots on drag link.
4. Remove idler and pitman arm pivots from drag link using Puller, J-22292, Fig. 9-68.

(NOTE: It may be necessary to loosen steering gear at frame to remove drag link from pitman arm.)

5. Remove cotter pins and nuts from outer tie rod pivots at steering knuckles.
6. Remove tie rod pivots from steering knuckles using Tie Rod End Puller, J-21930.
7. Remove linkage from car.
8. Remove bolt and locknut securing idler arm to frame and remove idler arm from car.

b. Disassembly

1. Remove cotter pins and nuts from inner tie rod pivots.
2. Remove tie rods using Tie Rod End Puller, J-21930.
3. Remove outer tie rod pivots by loosening nuts on outer clamp bolts and unscrewing pivots from adjuster tube.
4. Loosen nuts on inner clamp bolts and unscrew tie rod inner pivots from adjuster tubes.

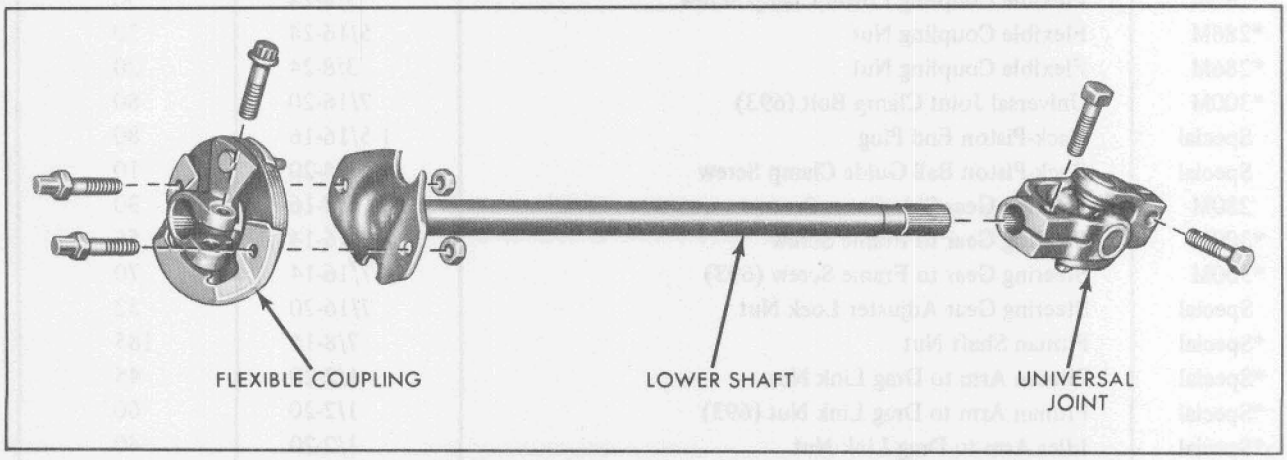


Fig. 9-69 Lower Steering Shaft – 693

5. Remove bolts securing dampener to bracket on drag link and remove dampener and spacer.

c. Assembly

1. Position steering dampener and spacer to brackets on drag link. Spacer should be positioned between dampener attachment and upper part of bracket.

2. Attach dampener to bracket with bolt and tighten to 40 foot-pounds.

3. Lubricate adjuster tube with chassis lubricant, install adjuster tubes and clamps on tie rod inner pivots.

4. Thread tie rod outer pivots into adjuster tubes.

(NOTE: An equal amount of thread must be exposed on both ends of the adjuster tubes.)

5. Install both tie rods on drag link, tighten nuts to 60 foot-pounds and install cotter pins. If cotter pin cannot be installed, tighten nut to next hole location and install cotter pin. *See CAUTION on page 9-21.*

d. Installation

See CAUTION on page 9-21 when performing steps 1, 2 and 3.

1. Install idler arm on frame with bolt and locknut. Tighten bolt to 95 foot-pounds.

2. Install drag link on pitman arm and idler arm pivots and tighten pivot nuts to 60 foot-pounds. Install cotter pins.

3. Install outer tie rod pivots to steering knuckles and tighen nuts to 37 foot-pounds. Install cotter pins.

4. Install dampener to frame bracket, tighten bolt to 40 foot-pounds.

5. Install front wheels on car.

6. Adjust alignment as described in Section 3, Note 20.

28. Steering Linkage Parallelism (693)

1. Set front standing height as specified in Fig. 3-37.

2. Measure steering linkage to lower control arm frame attachment distance, left and right. These dimensions should be equal.

3. Loosen the steering gear mounting bolts. Rotate the gear on the bolts to equalize the measurements of step 2. If not sufficient continue to steps 4 and 5.

4. If right side of drag link is high, remove the oil filter, saving the filter and the oil. Push the top of the idler arm frame bracket rearward until drag link measurements in step 2 are equal. Reinstall oil filter and oil.

5. If left side of drag link is high, bend the top of the idler arm frame bracket forward until the measurements in step 2 are equal.

6. Adjust alignment as described in Section 3, Note 20.

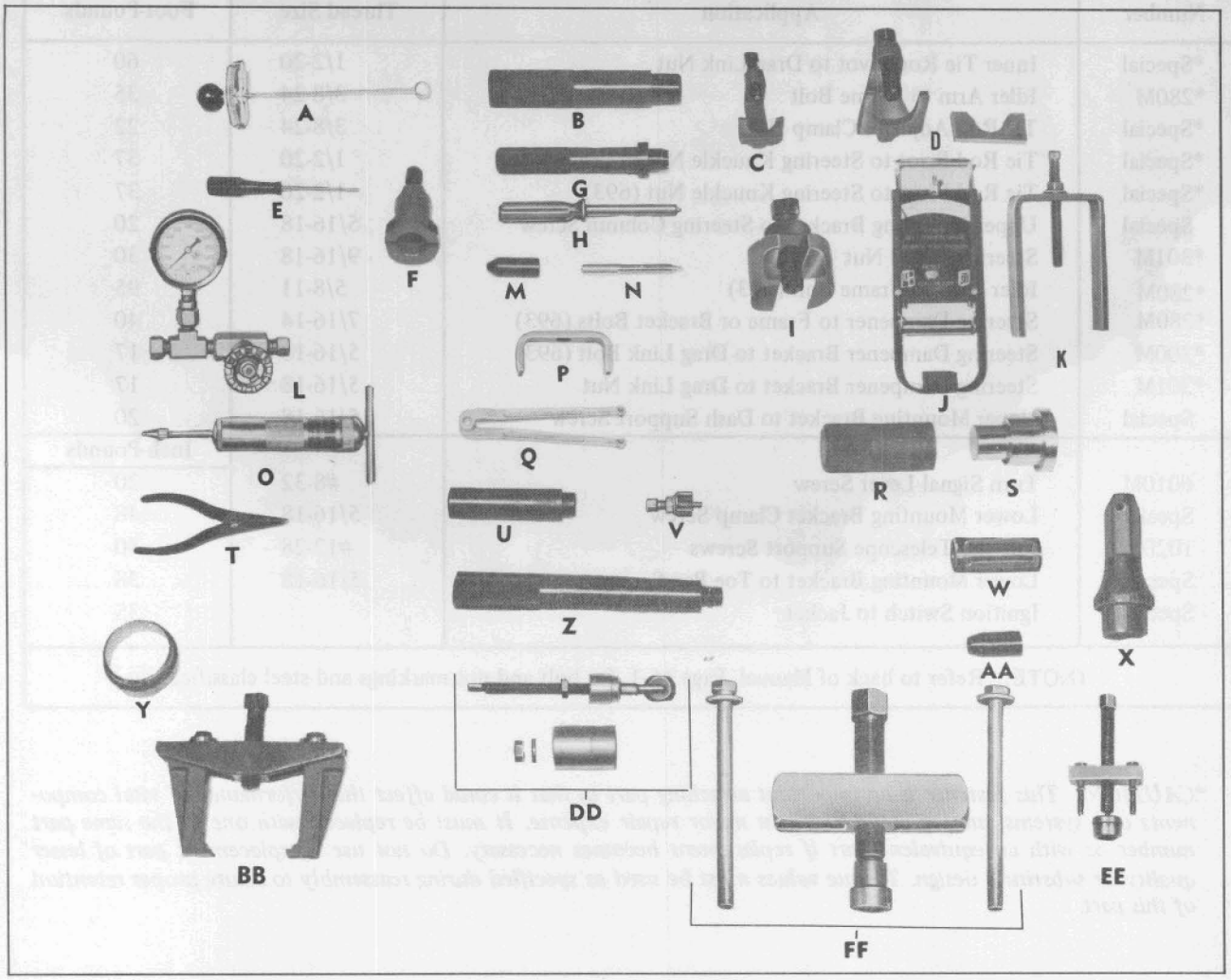
TORQUE SPECIFICATIONS

Material Number	Application	Thread Size	Foot-Pounds
280M	Mounting Bracket to Pump Screw	3/8-16	32
Special	Pump Pressure Unions	5/8-18	32
286M	Pump Pulley Nut	9/16-18	47
260M	Pump Mounting Bracket to Engine Screw	3/8-16	22
*260M	Flexible Coupling Upper Clamp Screw	3/8-24	30
*280M	Flexible Coupling Lower Clamp Screw	3/8-24	30
*286M	Flexible Coupling Nut	5/16-24	20
*286M	Flexible Coupling Nut	3/8-24	20
*300M	Universal Joint Clamp Bolt (693)	7/16-20	80
Special	Rack-Piston End Plug	1-5/16-16	80
Special	Rack-Piston Ball Guide Clamp Screw	1/4-20	10
280M	Steering Gear Side Cover Screws	3/8-16	30
*300M	Steering Gear to Frame Screw	7/16-14	55
*300M	Steering Gear to Frame Screw (693)	7/16-14	70
Special	Steering Gear Adjuster Lock Nut	7/16-20	32
*Special	Pitman Shaft Nut	7/8-14	185
*Special	Pitman Arm to Drag Link Nut	1/2-20	45
*Special	Pitman Arm to Drag Link Nut (693)	1/2-20	60
*Special	Idler Arm to Drag Link Nut	1/2-20	40
*Special	Idler Arm to Drag Link Nut (693)	1/2-20	60

Material Number	Application	Thread Size	Foot-Pounds
*Special	Inner Tie Rod Pivot to Drag Link Nut	1/2-20	60
*280M	Idler Arm to Frame Bolt	3/8-24	35
*Special	Tie Rod Adjuster Clamp Nut	3/8-24	22
*Special	Tie Rod Pivot to Steering Knuckle Nut	1/2-20	37
*Special	Tie Rod Pivot to Steering Knuckle Nut (693)	1/2-20	37
Special	Upper Mounting Bracket to Steering Column Screw	5/16-18	20
*301M	Steering Wheel Nut	9/16-18	30
*280M	Idler Arm to Frame Bolt (693)	5/8-11	95
*280M	Steering Dampener to Frame or Bracket Bolts (693)	7/16-14	40
*300M	Steering Dampener Bracket to Drag Link Bolt (693)	5/16-18	17
*301M	Steering Dampener Bracket to Drag Link Nut	5/16-18	17
Special	Upper Mounting Bracket to Dash Support Screw	5/16-18	20
			Inch-Pounds
6010M	Turn Signal Lever Screw	#8-32	20
Special	Lower Mounting Bracket Clamp Screw	5/16-18	48
1020	Tilt and Telescope Support Screws	#12-28	50
Special	Lower Mounting Bracket to Toe Pan Screws	5/16-18	38
Special	Ignition Switch to Jacket		35
(NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings and steel classification.)			

**CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

SPECIAL TOOLS



Key	Tool No.	Name	Key	Tool No.	Name
A	J-7754	Torque Wrench (0-25 inch-pounds)	R	J-6219	Pitman Shaft Seal Installer
B	J-6657	Pitman Shaft Bearing Remover	S	J-22407	Pitman Shaft Bearing Installer
C	J-21930	Tie Rod End Puller	T	J-4245	Snap Ring Pliers
D	J-22292	Steering Linkage Puller	U	J-6221	Adjuster Plug Bearing Remover and Installer
E*	J-22635	Pin Remover			
F	J-21883	Pump Pulley Puller	V*	J-21854-01	Hardened Step Screw and Pivot Pin Adapter
G	J-5188	Adjuster Plug Seal Installer			
H	J-21552	Rack-Piston Arbor	W	J-7728	Pump Shaft Oil Seal Installer
I	J-6632	Pitman Arm Puller	X	J-21150	Seal Installer
J	J-23600	Belt Tension Gage	Y	J-7576	Rack-Piston Seal Compressor
K*	J-23063	Carrier and Spring Compressor	Z	J-8092	Universal Handle
L	J-5176-01	Pressure Testing Gage Assembly	AA	J-6222	Adjuster Plug Seal Protector
M	J-22616	Pump Shaft Oil Seal Protector	BB	J-8990	Steering Linkage Puller
N	J-6217	Valve Connector Seat Installer	DD*	J-23073	Shift Tube Installer
O	J-9280	Packing Gun	EE*	J-23072	Shift Tube Remover
P	J-23131	Carrier and Spring Compressor	FF	J-1859-03	Steering Wheel Puller
Q	J-7624	Spanner Wrench			

*Denotes Tilt and Telescope column only.

Fig. 9-70 Special Tools

GENERAL DESCRIPTION

Wheels

The wheels used on all 1972 Cadillac cars have a drop center rim design. They are secured to the hub by five right hand threaded nuts. Valve stem replacements, installation torques, and wheel descriptions are given in the Wheel, Valve, and Fastening Table.

Tires

The original equipment tires installed on all 1972 Cadillac cars are selected to provide the best all around tire performance for normal operation. They are designed to operate satisfactorily with loads up to and including the specified full rated load capacity of the car when inflated as recommended in the Tire Usage and Inflation Pressure Table, Fig. 10-1.

WHEEL, VALVE, AND FASTENING TABLE

Wheel, Valve, and Fastening Table	Calais, De Ville, and Brougham	Fleetwood Seventy Five Commercial Vehicle	Eldorado
Wheel Size and Flange Type	15x6JK	15 x 6JK	15x6JK
Spider to Rim Attachment	Spot Welded	Riveted	Riveted
Offset (Rim Center Line to Mounting Surface)	.29 In.	.29 In.	3.25 In.
Wheel Identification	SA	SB	SC
Valve Stem	T.R. 413	T.R. 413	T.R. 417
(Number of Fasteners), Bolt Circle	(5), 5.0 In.	(5), 5.0 In.	(5), 5.0 In.
Fastener Torque	105 ft. lbs.	105 ft. lbs.	105 ft. lbs.

10

TIRE USAGE AND INFLATION PRESSURE TABLE—Pounds per square inch cold

Calais, DeVille & Fleetwood Sixty Special Brougham		TIRE SIZE DESIGNATION
		L78-15 (Load Range B)
STANDARD INFLATION PRESSURES	For all loads, including full rated load, 6 passengers plus 200 lb. trunk load (1100 lb. total)	Front 22 Rear 26
OPTIONAL INFLATION PRESSURES	For reduced loads, 1 to 5 passengers (750 lb. total)	Front 22 Rear 22

Eldorado		TIRE SIZE DESIGNATION
		L78-15 (Load Range B)
STANDARD INFLATION PRESSURES	For all loads, including full rated load, 6 passengers plus 200 lb. trunk load (1100 lb. total)	Front 25 Rear 20
OPTIONAL INFLATION PRESSURES	For reduced loads, 1 to 5 passengers (750 lb. total)	Front 24 Rear 17

Fleetwood Seventy-Five		TIRE SIZE DESIGNATION
		L78-15 (Load Range D)
STANDARD INFLATION PRESSURES	For all loads, including full rated load, 9 passengers plus 200 lb. trunk load (1550 lb. total)	Front 28 Rear 36
OPTIONAL INFLATION PRESSURES	For reduced loads, 1 to 5 passengers (750 lb. total)	Front 28 Rear 28

Tire inflation pressure may increase as much as 6 pounds per square inch (psi) when hot.

For continuous high speed operation (over 75 mph) increase tire inflation pressure 4 pounds per square inch over the recommended pressures up to a maximum of 32 pounds per square inch cold for load range B tires, or 40 pounds per square inch cold for load range D tires. Sustained speeds above 75 mph are not recommended when the 4 pounds per square inch adjustment would require pressures greater than the maximum stated above.

Cold tire inflation pressure: after vehicle has been inoperative for 3 hours or more, or driven less than 1 mile. Hot tire inflation pressure: after vehicle has been driven 10 miles or at speeds of more than 60 miles per hour.

Vehicles with luggage racks do not have a vehicle load limit greater than specified.

When towing trailers, the allowable passenger and cargo load must be reduced by an amount equal to the trailer tongue load on the trailer hitch.

Fig. 10-1 Tire Usage and Inflation Pressure Table

SERVICE INFORMATION

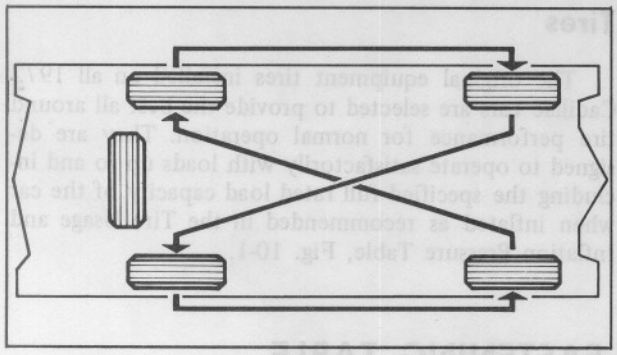


Fig. 10-2 Tire Rotation

1. Tire Rotation

To equalize tire wear, it is recommended that tires be rotated every 6,000 miles on all 1972 Cadillacs.

Tire rotation on the Eldorado may be required more frequently if the car is driven under extreme operating conditions, such as those listed below.

1. High speed cornering.
2. Severe cornering.
3. Rapid acceleration, causing slippage of the driving wheels.
4. Unusually abrasive road surfaces.

A suggested rotation interval when the Eldorado is operated under these extreme operating conditions is every 4,000 miles.

Tires should be rotated according to the pattern shown in Fig. 10-2. Inspect tires and tire pressures prior to rotating, and adjust tire pressures (front and rear) after rotation in accordance with recommendations in the Tire Usage And Inflation Pressure Table, Fig. 10-1.

2. Tire Inspection

A decrease in traction, anti-skid properties, and road hazard resistance occurs as tires become worn. The original equipment tires used on all 1972 Cadillacs incorporate built-in tread wear indicators to assist the owner in judging when tires should be replaced. These indicators are molded into the bottom of the tread grooves and will appear as 1/2 inch wide bands when tire tread depth becomes 1/16 of an inch, Fig. 10-3.

Tire inspection consists of observation for, and correction of, the following:

1. Abnormal wear.
2. Bulges or other irregularities.
3. Objects puncturing tire.
4. Tread cracks or cuts.
5. Sidewall cracks, cuts, or scuffs.
6. Unusually low inflation pressures, indicating possible leakage.
7. Missing valve caps or damaged valve stems.
8. Loose, missing, or defective wheel fasteners.
9. Damaged or defective wheels.
10. Improper tire size or rating.

3. Tire Wear

Improper inflation pressures will cause abnormal wear conditions like those shown in Fig. 10-4.

a. Underinflation Wear

Underinflation results in abnormal wear of the tread shoulder, caused by the tires rolling on the shoulders with a wiping action.

In addition, underinflated tires are subjected to excessive flexing, causing high internal temperatures and cracking of the sidewall.

b. Overinflation Wear

Overinflation causes the center section of the tread to receive excessive driving and braking loads, so that the center section is worn more than the shoulders. An overinflated tire is subject to breaks in the fabric from severe impacts and is more easily cut or punctured.

c. Toe-in or Toe-out Wear

Excessive toe-in or toe-out has the effect of dragging the tires sideways down the road, which results in feathering the raised portions of the tread.

Improper toe-in is indicated by feather edges on the inner side of the tread. Toe-out is indicated by the feather edges on the outer side of the tread.

d. Camber Wear

Excessive positive camber will cause wear on the outer side of the tread. Excessive negative camber will cause wear on the inner side of the tread. Camber wear may also be evident if the car is driven continually on highly crowned roads.

e. Wear Due to Mechanical Conditions

Loose parts of the front suspension system, such as

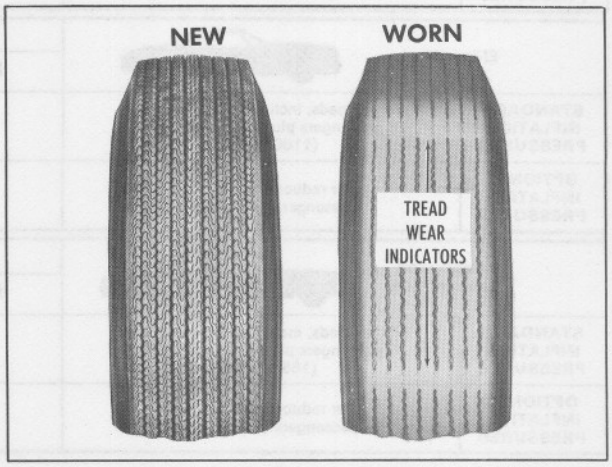


Fig. 10-3 Tread Wear Indicators

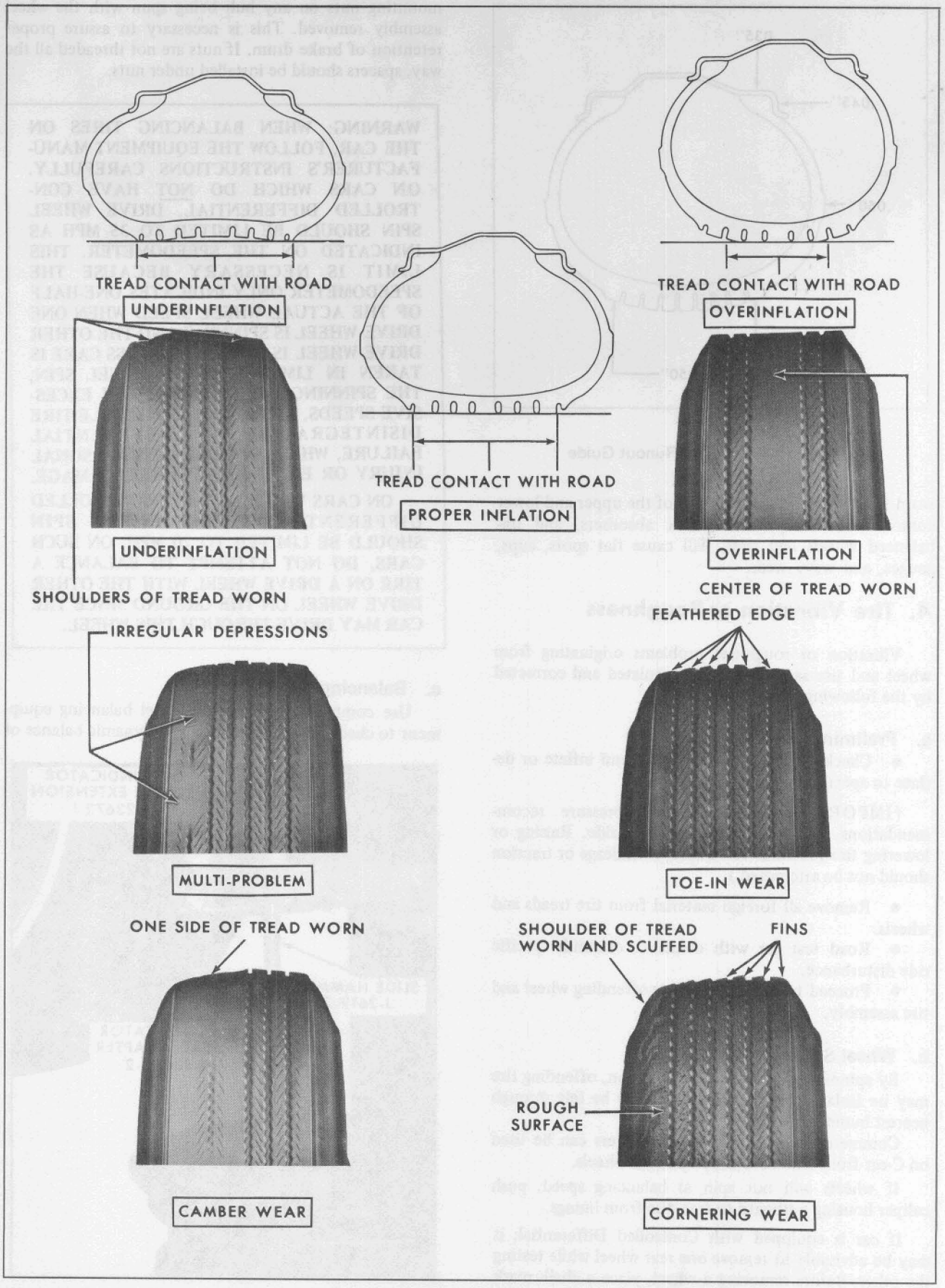


Fig. 10-4 Tire Wear Patterns

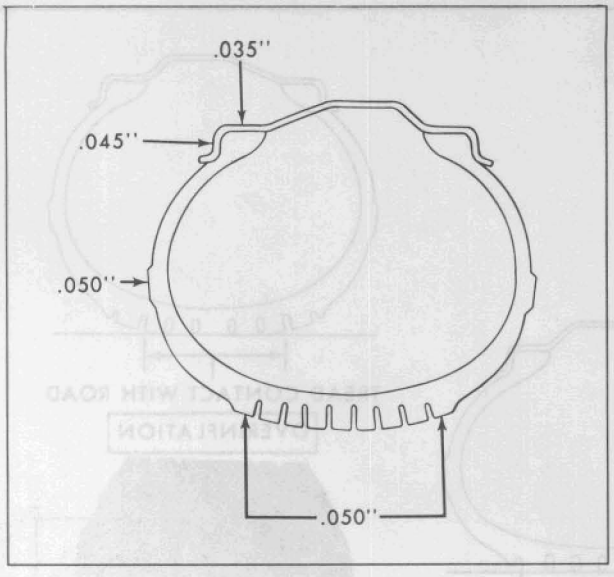


Fig. 10-5 Wheel and Tire Runout Guide

worn spherical joints, mountings of the upper and lower control arms, inoperative shock absorbers, and unbalanced wheels and tires, will cause flat spots, cups, gouges, and wavy wear.

4. Tire Vibration or Roughness

Vibration or roughness problems originating from wheel and tire assemblies can be isolated and corrected by the following procedure:

a. Preliminary Checks

- Check all tire pressures (cold) and inflate or deflate to specification.

(IMPORTANT: Tire inflation pressure recommendations are critical for a smooth ride. Raising or lowering tire pressures to "improve" mileage or traction should not be attempted.)

- Remove all foreign material from tire treads and wheels.
- Road test car with owner to establish specific ride disturbance.
- Proceed to Part b to isolate offending wheel and tire assembly.

b. Wheel Spinning

By spinning each wheel in succession, offending tire may be isolated by vibration that may be felt through nearest bumper or fender

Commercially available wheel spinners can be used on C-car front wheels or Eldorado rear wheels.

If wheels will not spin at balancing speed, push caliper housing outboard to free disc from linings.

If car is equipped with Controlled Differential, it may be advisable to remove one rear wheel while testing the other. Before removing a wheel, place a chalk mark on a stud and its corresponding lug bolt hole for proper orientation on assembly. Be sure to replace several wheel mounting nuts on any hub being spun with the wheel assembly removed. This is necessary to assure proper retention of brake drum. If nuts are not threaded all the way, spacers should be installed under nuts.

WARNING: WHEN BALANCING TIRES ON THE CAR, FOLLOW THE EQUIPMENT MANUFACTURER'S INSTRUCTIONS CAREFULLY. ON CARS WHICH DO NOT HAVE CONTROLLED DIFFERENTIAL, DRIVE WHEEL SPIN SHOULD BE LIMITED TO 35 MPH AS INDICATED ON THE SPEEDOMETER. THIS LIMIT IS NECESSARY BECAUSE THE SPEEDOMETER ONLY INDICATES ONE-HALF OF THE ACTUAL WHEEL SPEED WHEN ONE DRIVE WHEEL IS SPINNING AND THE OTHER DRIVE WHEEL IS STOPPED. UNLESS CARE IS TAKEN IN LIMITING DRIVE WHEEL SPIN, THE SPINNING WHEEL CAN REACH EXCESSIVE SPEEDS, RESULTING IN POSSIBLE TIRE DISINTEGRATION OR DIFFERENTIAL FAILURE, WHICH COULD CAUSE PERSONAL INJURY OR EXTENSIVE VEHICLE DAMAGE.

ON CARS WHICH DO HAVE CONTROLLED DIFFERENTIAL, DRIVE WHEEL SPIN SHOULD BE LIMITED TO 70 MPH. ON SUCH CARS, DO NOT ATTEMPT TO BALANCE A TIRE ON A DRIVE WHEEL WITH THE OTHER DRIVE WHEEL ON THE GROUND SINCE THE CAR MAY DRIVE THROUGH THIS WHEEL.

c. Balancing

Use commercially available wheel balancing equipment to check and correct static and dynamic balance of



Fig. 10-6 Checking Radial Runout of Tire



Fig. 10-7 Checking Lateral Runout of Tire

offending wheel and hub assemblies. Follow manufacturer's instructions.

d. Correcting Excessive Runout

Vibrations not isolated by wheel spinning or balancing are often due to excessive runout of wheel and/or tire.

To correct this condition, perform the following

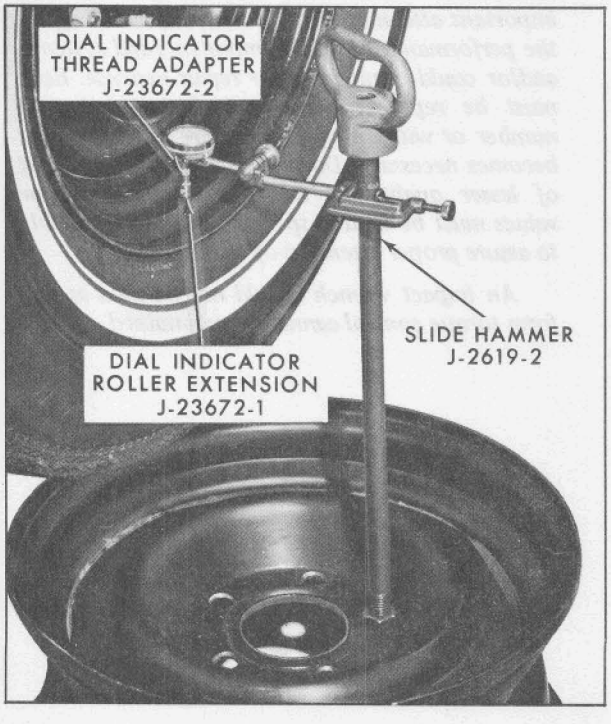


Fig. 10-8 Checking Radial Runout of Wheel

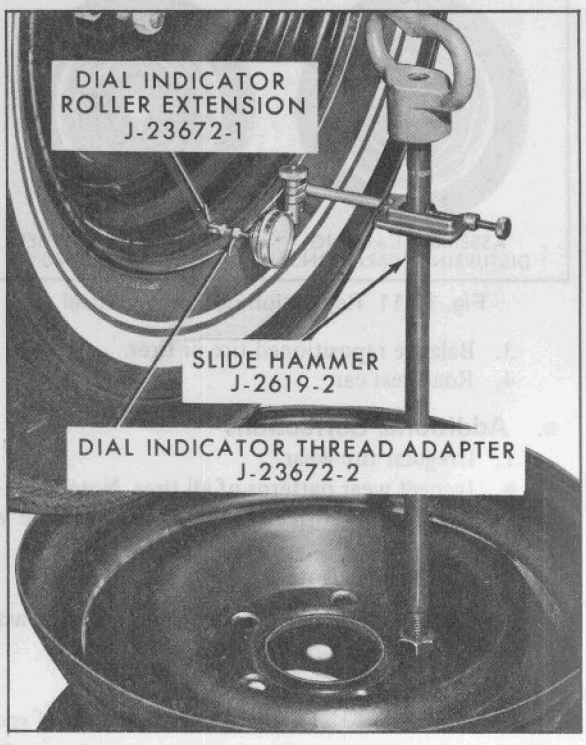


Fig. 10-9 Checking Lateral Runout of Wheel

procedures:

1. Using maximum allowable runouts in Fig. 10-5 as a guide, check lateral and radial runouts of wheels and tires as in Figs. 10-6, 10-7, 10-8, and 10-9. Use Dial Indicator, J-8001, Dial Indicator Roller Extension, J-23672-1, and Dial Indicator Thread Adapter, J-23672-2. Stand should weigh at least ten pounds. This stand was made from a spare wheel and Slide Hammer, J-2619-2.

2. If any of the four runout measurements exceed the corresponding measurements in Fig. 10-5, reposition tire 180° from its original location on the wheel, Fig. 10-11, and Note 5.

(NOTE: Do not reposition wheel and tire assemblies that do not exceed runout guide.)

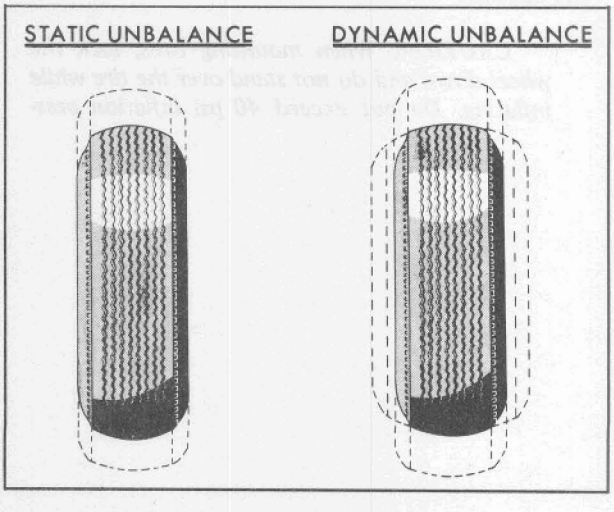


Fig. 10-10 Static and Dynamic Unbalance

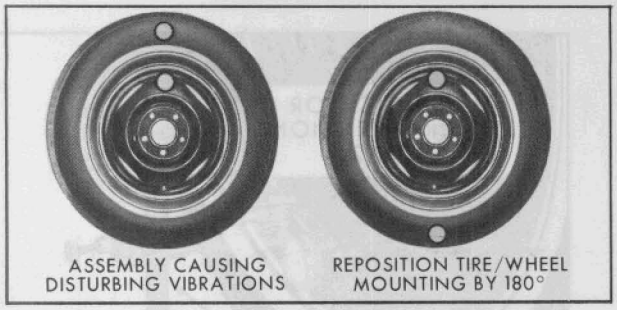


Fig. 10-11 Repositioning Tire on Wheel

3. Balance repositioned tire or tires.
4. Road test car.

e. Additional Corrections

1. Irregular tire wear.

- Inspect wear patterns of all tires, Note 2.
- Locate and correct cause of irregular tire wear, Note 3.
- Rotate tires, Note 1.

(NOTE: If necessary, place wheel and tire assemblies with lowest runouts in front of car.)

2. Pinion Flange Runout

Combined face and radial runout in excess of specification may create symptoms similar to tire vibrations. Check pinion flange runout, Section 4, Note 46.

5. Tire Mounting and Demounting

The following precautions should be observed during tire mounting on or demounting from the wheel rim:

1. Start with the narrow ledge of the rim up, regardless of which side of wheel the narrow ledge is on. (Special adapters may be required with certain equipment for mounting or demounting tires on the Eldorado.)

2. Clean the rim in the ledge and flange areas and coat both areas thoroughly with an approved rubber lubricant prior to mounting.

3. Use of one of several devices which are available to assist in bead unseating or seating will be helpful; however, sharp objects or forcing of the bead may cause tire damage.

CAUTION: When mounting tires, lock the wheel down and do not stand over the tire while inflating. Do not exceed 40 psi inflation pressure, when seating tire on the wheel.

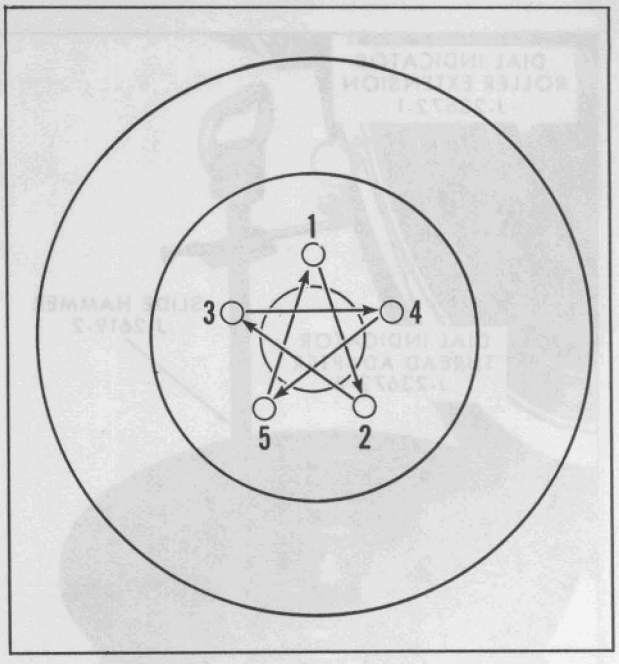


Fig. 10-12 Wheel Mounting Sequence

6. Installation of Wheel and Tire Assembly

1. Install wheel mounting nuts in a criss-cross pattern and tighten just enough to seat wheel against hub, to assure proper piloting of wheel on hub.

2. Tighten mounting nuts uniformly to 105 foot-pounds using criss-cross pattern, Fig. 10-12.

CAUTION: These wheel to hub fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

An impact wrench should not be used as uniform torque control cannot be maintained.

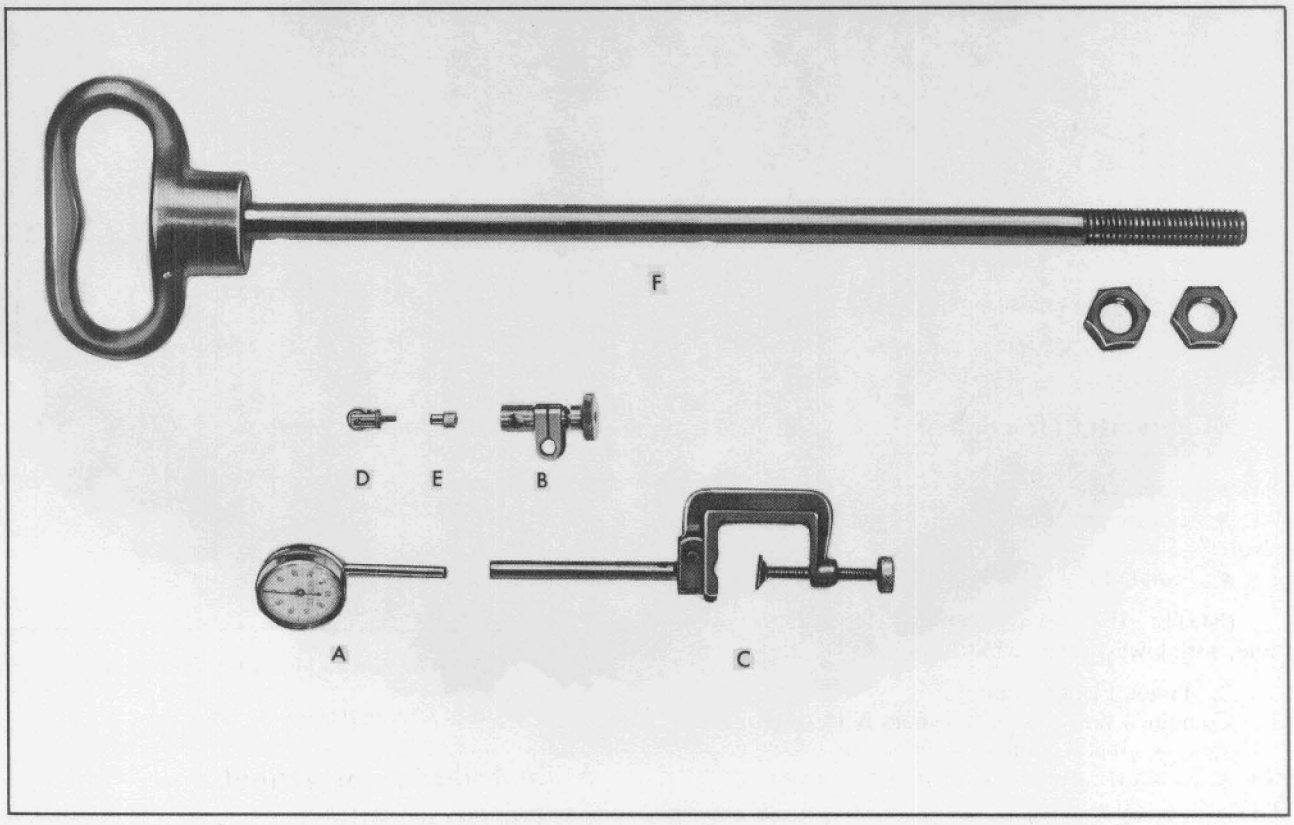
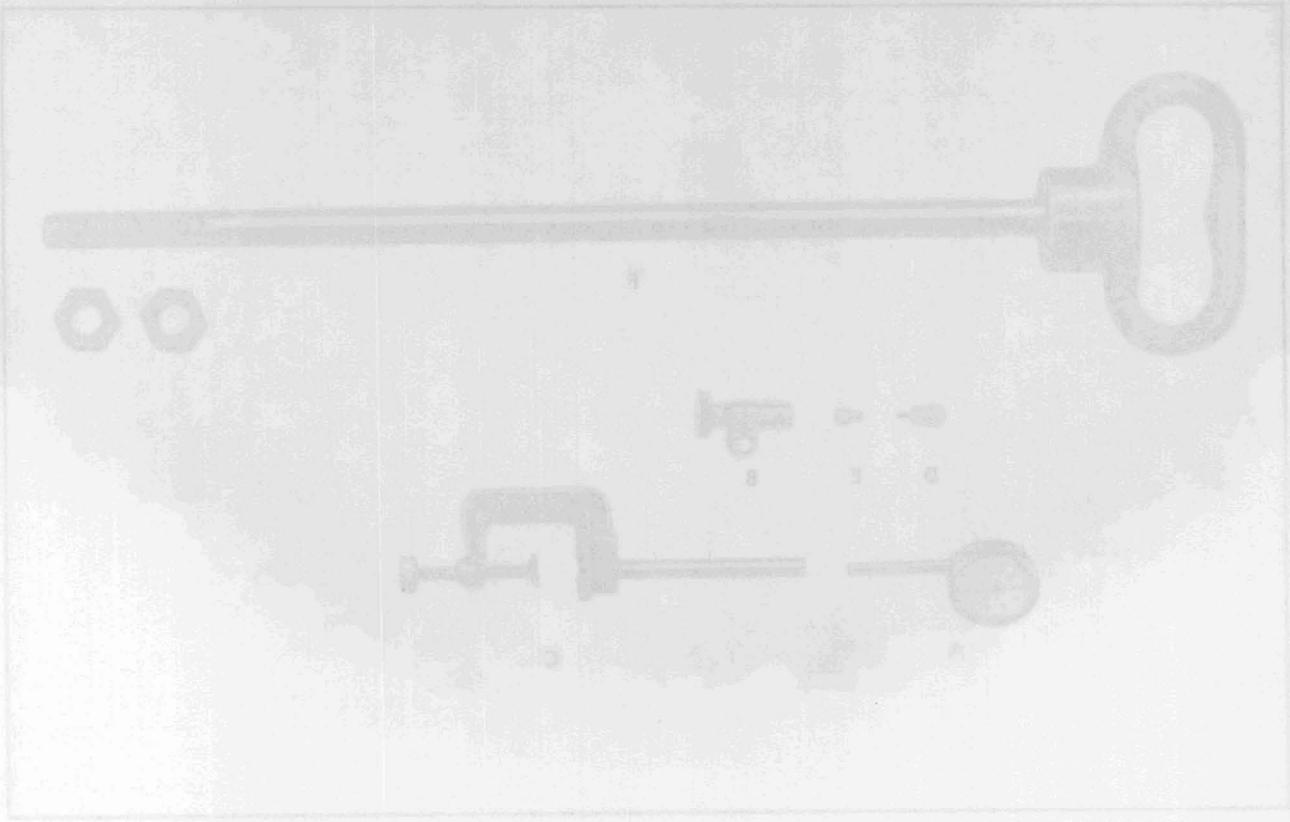


Fig. 10-13 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-8001-3	Dial Indicator	D	J-23672-1	Dial Indicator Roller Extension
B	J-8001-2	Sleeve	E	J-23672-2	Dial Indicator Thread Adapter
C	J-8001-1	Clamp	F	J-2619-2	Slide Hammer



GENERAL DESCRIPTION

(NOTE: For information pertaining to the Eldorado, refer to the latter portion of this section.)

The 1972 Cadillac chassis sheet metal described in this section consists of the following items: hood, front fenders and wheel housing.

The hood is hinged near the cowl and opens from the front. The hood primary lock is located in the center of the hood lock tie bar on the radiator cradle.

The hood is unlocked by pulling on the hood lock release handle that is located on the left-hand kick panel just below the headlight switch, Fig. 11-1. The hood secondary latch release lever, Fig. 11-2, is accessible between the grille and hood panel after the primary lock has been actuated. Upward pressure on the hood latch secondary lever, Fig. 11-3, permits the hood to be raised.

SERVICE INFORMATION

1. Hood Latch Mechanism Adjustment

The hood latch assembly consists of a hood primary lock attached to the radiator cradle tie bar in the center by three screws and a hood secondary latch release lever attached to the hood inner panel by two screws into a tapping plate. Tighten primary latch screws to 30 foot-pounds and secondary latch screws to 18 foot-pounds.

CAUTION: These hood latch assembly fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with equivalent parts if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

The striker plate in the hood panel is large enough to take care of any fore and aft adjustment necessary. Cross car adjustment only, is provided at the hood lock mounting. Up and down adjustment is provided in the lock itself which has an automatic take up latch.

When the hood latch assembly has been removed, the mounting screws loosened, or the hood adjustment changed, make certain that proper alignment has been obtained before tightening the mounting screws. Failure to do so may result in damage to the latching assembly and/or excessive release handle efforts due to misalignment when the hood is closed.

The following procedure is recommended for checking 1972 model hood latch adjustments:

a. Drop hood from a height of 6 to 8 inches above closed position. The latch must engage.

b. The latch must release when release handle is pulled without lifting the hood.

Hood latches that do not engage or release properly must be corrected by proper adjustment of the hood latch and the hood adjustable bumpers. These adjustments are also used to bring the hood flush with the fenders.

c. Lower hood slowly until the striker plate rests on the latch. With hood in this position, secondary latch must be engaged under hood latch tie bar on radiator cradle, and must have a clearance of .24" maximum between latch hook and tie bar. Modeling clay on this latch can be used to help determine the dimension.

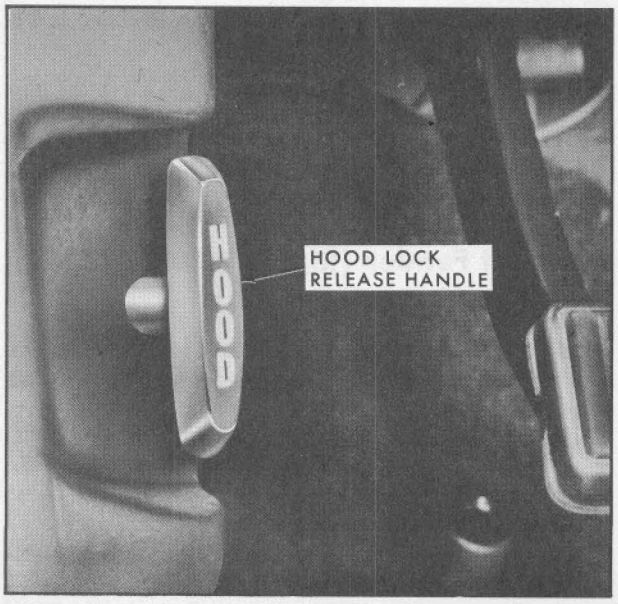


Fig. 11-1 Hood Lock Release Handle

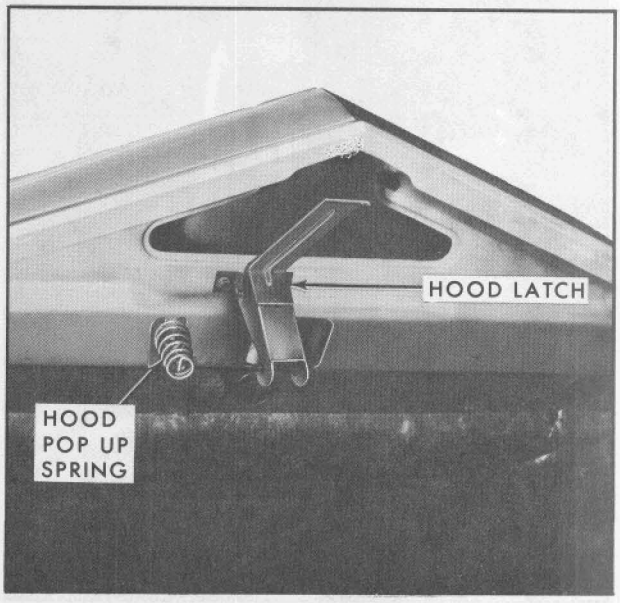


Fig. 11-2 Hood Release Lever

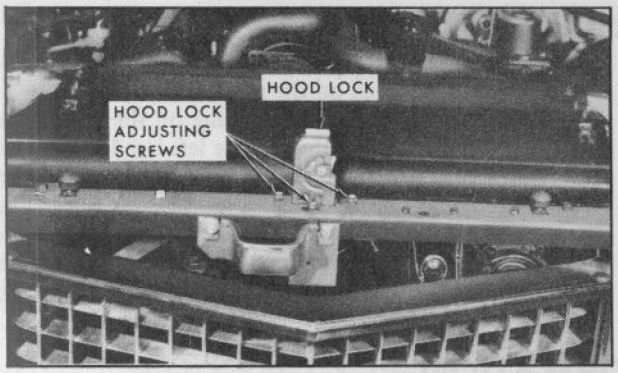


Fig. 11-3 Hood Lock

Secondary latches that do not meet these requirements must be adjusted by repositioning the secondary latch on the hood assembly.

d. Both primary and secondary latches must be free of excess friction or binding when operated.

2. Hood Panel

a. Removal (Fig. 11-4)

1. Scribe hinge locations on underside of hood panel to aid in repositioning the hood when it is reinstalled.

2. Remove six screws and washers, three each side, retaining hinge assemblies to hood panel.

3. Remove hood with the aid of a helper, using care to avoid damaging finish.

CAUTION: When hood is removed from car, never stand it upright on rear corners nose up. Hood must be positioned so that it rests on its side; otherwise, damage to sheet metal may result.

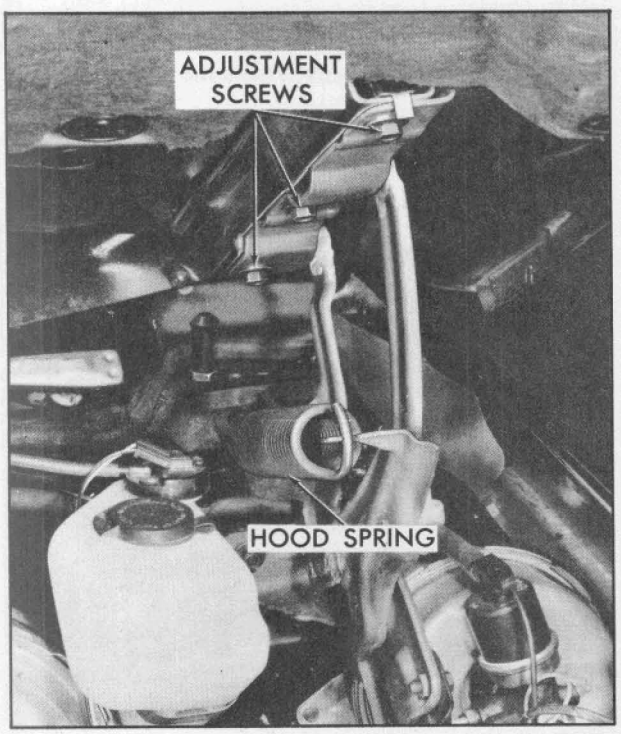


Fig. 11-4 Hood Hinge

b. Installation (Fig. 11-4)

(NOTE: Install an exhaust manifold stud in center holes of hood retaining plate to help locate and position adjusting screws when installing hood.)

1. With the aid of a helper, place hood in position on hood hinge assemblies and loosely install three screws and washers at each hinge assembly.

2. Position hood so that hinges line up with scribe marks and tighten screws at each hinge to 25 foot-pounds.

3. Carefully close hood and check alignment of hood at fender and grille opening.

4. Align hood, if necessary, as described in Note 3.

5. Adjust hood latch mechanism as described in Note 1.

3. Hood Adjustment

1. Loosen hood attaching screws, three at each hood hinge, Fig. 11-4. Elongated holes in hinge provide fore, aft, and side adjustment of hood. Position hood so that tolerances shown in Fig. 11-6 are provided.

2. Tighten hinge to hood attaching screws on both sides to 25 foot-pounds.

3. Adjust rubber bumpers, located on the tie bar, one each side, so that hood panel is flush with fenders at this point.

4. Adjust hood latch mechanism as described in Note 1.

4. Hood Hinge Spring

a. Removal (Fig. 11-4)

1. Open hood and prop as high as possible.

2. Using a strong wire hook, attach one end to center of pry bar of sufficient length and the other end to hinge spring.

3. With the aid of a helper, lift pry bar until spring disengages from hood hinge, then release pressure on bar slowly until spring is loose, then unhook other end of spring from hinge.

b. Installation (Fig. 11-4)

1. Hook one end of spring on hinge, then with the aid of a helper, use pry bar and wire hook to connect spring to front of hinge.

5. Front Fender (Right or Left)

a. Removal (Fig. 11-5)

1. If left fender is to be removed, disconnect negative battery cable. If right front fender is to be removed, remove the battery.

Note number of shims at each attaching, so that same number are installed during installation.

2. Apply masking tape to rear edge of fender to avoid scratching finish when removing fender.

3. Raise front end of car and remove wheel on side of car that fender is being removed.

4. Remove one screw with washer attached and shims retaining fender to door at lower hinge pillar.

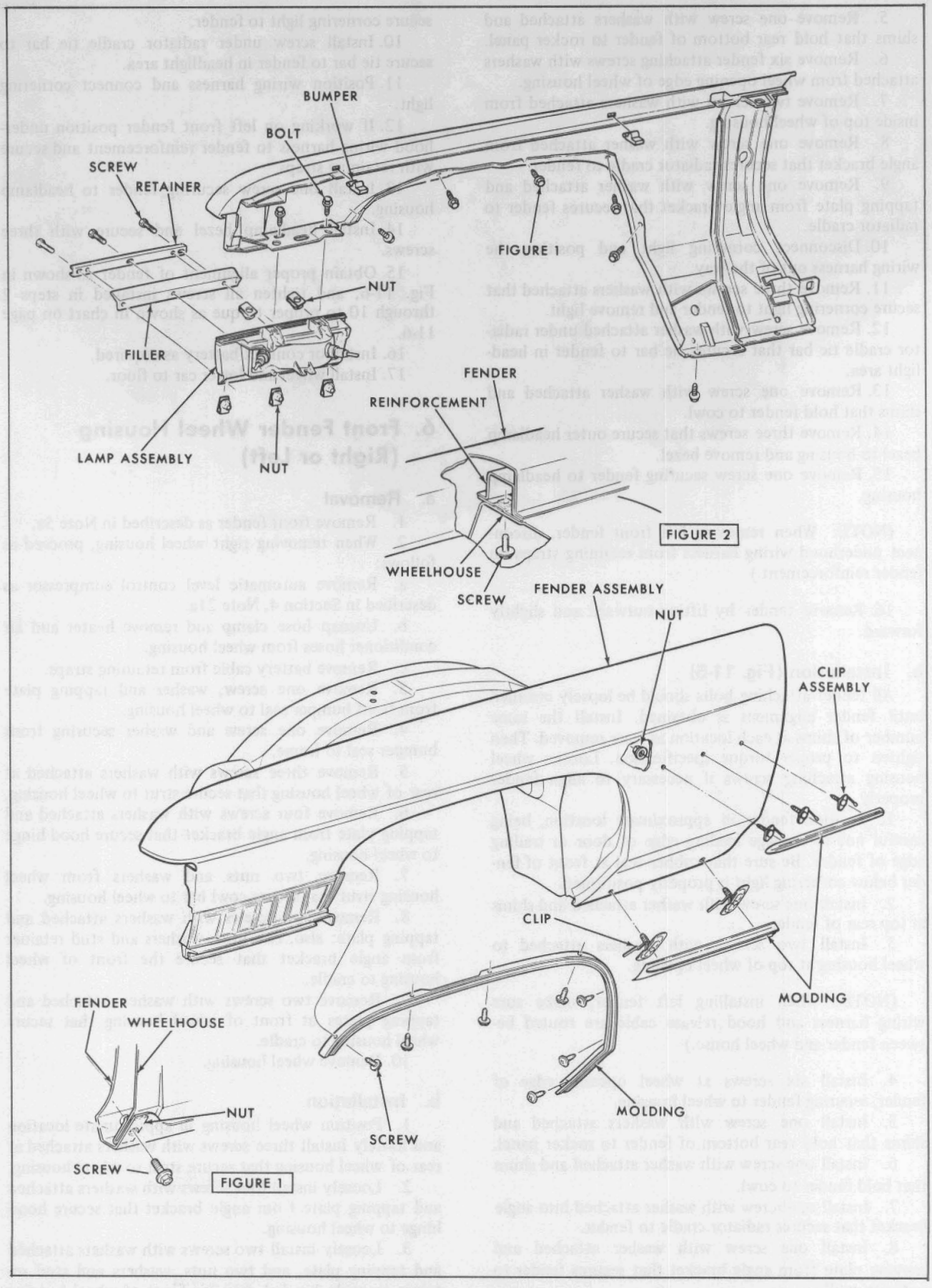


Fig. 11-5 Front Fender Disassembled

5. Remove one screw with washers attached and shims that hold rear bottom of fender to rocker panel.
6. Remove six fender attaching screws with washers attached from wheel opening edge of wheel housing.
7. Remove two screws with washers attached from inside top of wheel housing.
8. Remove one screw with washer attached from angle bracket that secures radiator cradle to fender.
9. Remove one screw with washer attached and tapping plate from angle bracket that secures fender to radiator cradle.
10. Disconnect cornering light and position the wiring harness out of the way.
11. Remove three screws with washers attached that secure cornering light to fender and remove light.
12. Remove screw with washer attached under radiator cradle tie bar that secures tie bar to fender in headlight area.
13. Remove one screw with washer attached and shims that hold fender to cowl.
14. Remove three screws that secure outer headlamp bezel to housing and remove bezel.
15. Remove one screw securing fender to headlamp housing.

(NOTE: When removing left front fender, disconnect underhood wiring harness from retaining straps on fender reinforcement.)

16. Remove fender by lifting outward and slightly forward.

b. Installation (Fig. 11-5)

All fender attaching bolts should be loosely installed until fender alignment is obtained. Install the same number of shims at each location as were removed. Then tighten to proper torque specification. Loosen wheel housing attaching screws if necessary to align fender properly.

1. Position fender in approximate location, being careful not to damage leading edge of door or trailing edge of fender. Be sure that rubber seal at front of fender below cornering light is properly positioned.
2. Install one screw with washer attached and shims at top rear of fender.
3. Install two screws with washers attached to wheel housing at top of wheel opening.

(NOTE: When installing left fender, make sure wiring harness and hood release cable are routed between fender and wheel house.)

4. Install six screws at wheel opening edge of fender, securing fender to wheel housing.
5. Install one screw with washers attached and shims that hold rear bottom of fender to rocker panel.
6. Install one screw with washer attached and shims that hold fender to cowl.
7. Install one screw with washer attached into angle bracket that secures radiator cradle to fender.
8. Install one screw with washer attached and tapping plate from angle bracket that secures fender to radiator cradle.
9. Install three screws with washers attached that secure cornering light to fender.
10. Install screw under radiator cradle tie bar to secure tie bar to fender in headlight area.
11. Position wiring harness and connect cornering light.
12. If working on left front fender position underhood wiring harness to fender reinforcement and secure with retaining straps.
13. Install one screw securing fender to headlamp housing.
14. Install headlamp bezel and secure with three screws.
15. Obtain proper alignment of fender as shown in Fig. 11-6, and tighten all screws installed in steps 2 through 10 to proper torque as shown in chart on page 11-6.
16. Install or connect battery as required.
17. Install wheel and lower car to floor.

6. Front Fender Wheel Housing (Right or Left)

a. Removal

1. Remove front fender as described in Note 5a.
2. When removing right wheel housing, proceed as follows:

a. Remove automatic level control compressor as described in Section 4, Note 21a.

b. Unsnap hose clamp and remove heater and air conditioner hoses from wheel housing.

c. Remove battery cable from retaining straps.

3. Remove one screw, washer and tapping plate from front bumper seal to wheel housing.
4. Remove one screw and washer securing front bumper seal to frame.
5. Remove three screws with washers attached at rear of wheel housing that secure strut to wheel housing.
6. Remove four screws with washers attached and tapping plate from angle bracket that secure hood hinge to wheel housing.
7. Remove two nuts and washers from wheel housing strut that secure cowl bar to wheel housing.
8. Remove two screws with washers attached and tapping plate; also, two nuts, washers and stud retainer from angle bracket that secure the front of wheel housing to cradle.
9. Remove two screws with washers attached and tapping plates at front of wheel housing that secure wheel housing to cradle.
10. Remove wheel housing.

b. Installation

1. Position wheel housing in approximate location and loosely install three screws with washers attached at rear of wheel housing that secure strut to wheel housing.
2. Loosely install four screws with washers attached and tapping plate from angle bracket that secure hood hinge to wheel housing.
3. Loosely install two screws with washers attached and tapping plate, and two nuts, washers and stud retainer in angle bracket securing front of wheel housing to cradle.

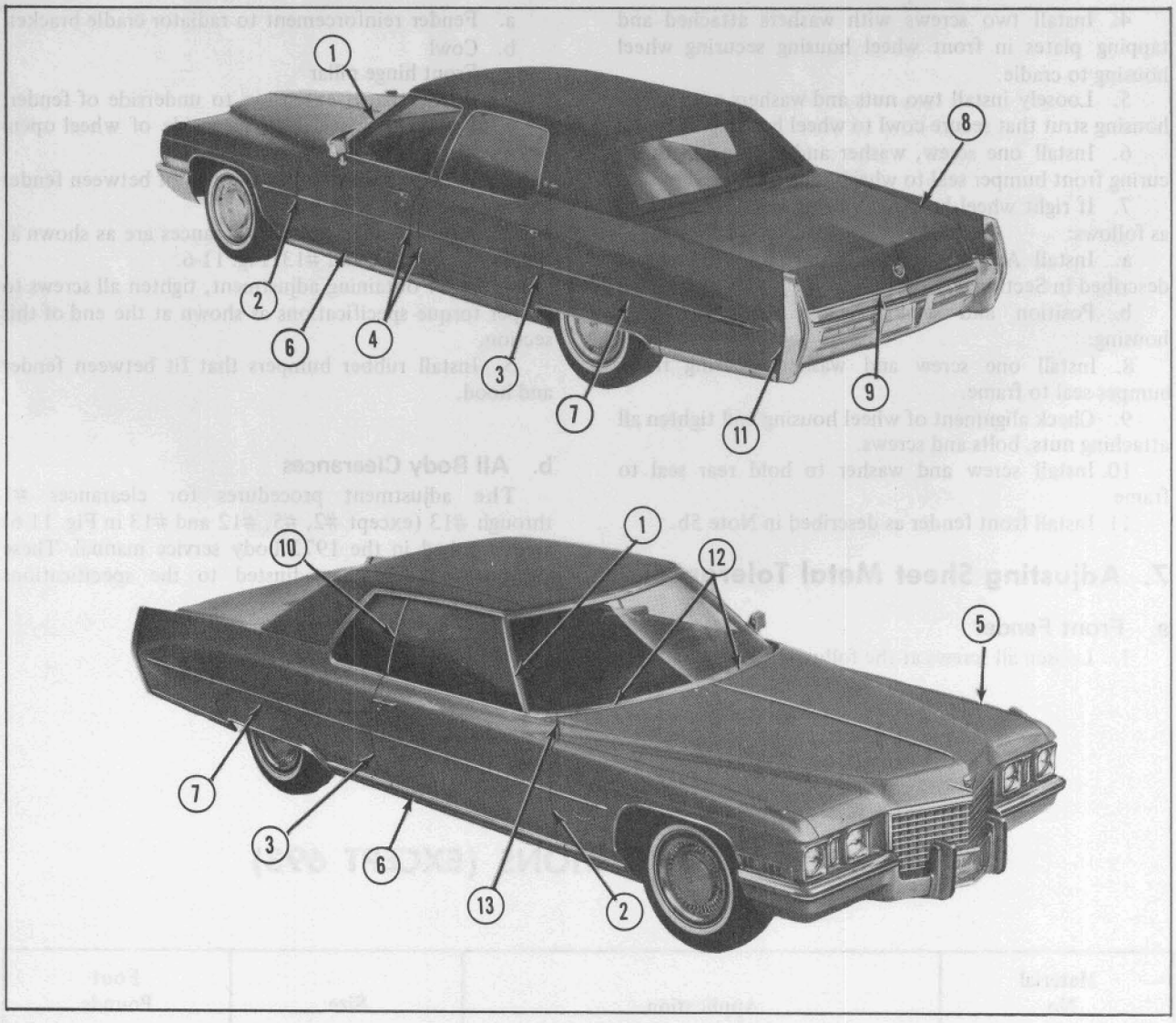


Fig. 11-6 Sheet Metal Tolerances

SHEET METAL TOLERANCES (EXCEPT 693)

Location	Style	Clearance Gap"	Flushness
1. Side window to windshield	All except	3/8-7/16	—
	23 and 33	1/8-1/4	—
2. Door to Fender	All	7/32-9/32	3/32+.00
3. Door to Quarter Panel	All	1/8-1/4	+0-1/16
4. Front Door to Rear Door	All	1/8-1/4	+0-1/16
5. Hood to Fender	All	3/32-5/32	±1/16
6. Door to Rocker Panel	All	1/8-1/4	—
7. Wheel Skirt to Quarter Panel	All	1/8-1/4	±1/16
8. Trunk Lid to Fender	All	1/16-1/4	±1/16
9. Trunk Lid to Bumper	All	5/16-7/16	—
10. Windows	49, 47 & 67 only	5/16-3/8	*
11. Bumper to Quarter Panel	All	3/8-11/16	—
12. Hood to Windshield Wiper Arm	All	1/8 Min.	—
13. Hood to Door	All	7/32-9/32	±1/16

*May be out of plane if weatherstrip provides watertight seal.

4. Install two screws with washers attached and tapping plates in front wheel housing securing wheel housing to cradle.

5. Loosely install two nuts and washers onto wheel housing strut that secure cowl to wheel housing.

6. Install one screw, washer and tapping plate securing front bumper seal to wheel housing.

7. If right wheel housing is being installed, proceed as follows:

a. Install Automatic Level Control compressor as described in Section 4, Note 21b.

b. Position and secure heater hoses to wheel housing.

8. Install one screw and washer securing front bumper seal to frame.

9. Check alignment of wheel housing and tighten all attaching nuts, bolts and screws.

10. Install screw and washer to hold rear seal to frame.

11. Install front fender as described in Note 5b.

7. Adjusting Sheet Metal Tolerances

a. Front Fender

1. Loosen all screws at the following locations:

a. Fender reinforcement to radiator cradle bracket.

b. Cowl

c. Front hinge pillar

d. Rocker panel extension to underside of fender.

e. Fender to wheel housing inside of wheel opening.

2. Remove rubber bumpers that fit between fender and hood.

3. Adjust fender so that clearances are as shown at points #2, #5, #12 and #13, Fig. 11-6.

4. After obtaining adjustment, tighten all screws to proper torque specifications as shown at the end of this section.

5. Install rubber bumpers that fit between fender and hood.

b. All Body Clearances

The adjustment procedures for clearances #1 through #13 (except #2, #5, #12 and #13 in Fig. 11-6) are described in the 1972 body service manual. These clearances should be adjusted to the specifications shown in Fig. 11-6.

TORQUE SPECIFICATIONS (EXCEPT 693)

Material No.	Application	Size	Foot Pounds
260M	Hood Hinge to Hood	3/8-16	25
260M	Hood Hinge to Cowl	3/8-16	30
6010M	Secondary Latch to Hood	5/16-18	*18
286M	Primary Latch Pilot to Tie Bar	1/2-20	*30
260M	Front Fender to Radiator Cradle	3/8-16	25
Special	Front Fender to Cowl	3/8-16	25
Special	Front Fender to Rocker Panel	3/8-16	25
Special	Front Fender to Hinge Pillar	3/8-16	25
NOTE: Refer to back of manual, Page 16-1, for bolt and nut markings, and steel classifications.			

**CAUTION: These hood latch assembly fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with equivalent parts if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

GENERAL DESCRIPTION

The 1972 Cadillac Eldorado sheet metal described in this section consists of the following items: hood, front fenders, and wheel housing.

The hood is hinged near the cowl and opens from the front. The hood lock latch is located in the center of the hood lock tie bar on the radiator cradle.

The hood is unlocked by pulling on the hood release handle that is located on the left hand kick panel just below the headlight switch, Fig. 11-7. The hood latch release lever, Fig. 11-8, is accessible between the grille and hood panel. After the primary lock has been actuated upward, pressure on the hood latch secondary lever, Fig. 11-9, permits the hood to be raised.

The front fender assemblies provide mounting attachments that incorporate the cornering and side marker and parking and turn signal lamp assemblies.

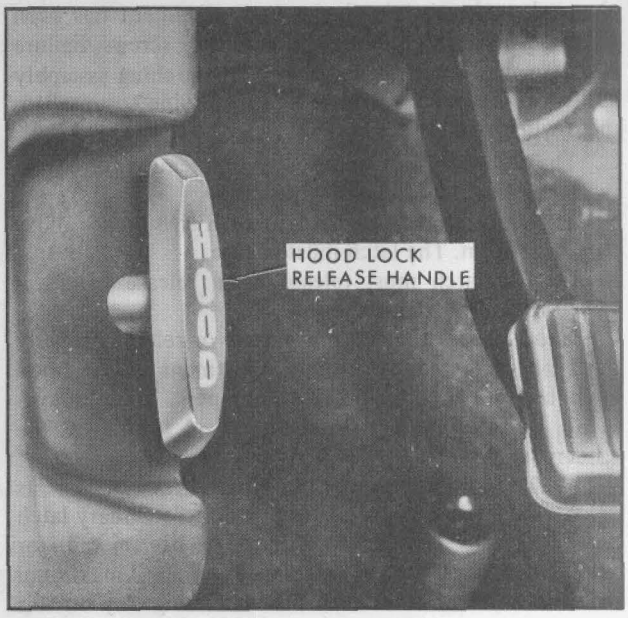


Fig. 11-7 Hood Lock Release Handle

SERVICE INFORMATION

8. Hood Latch Mechanism Adjustment

The hood latch assembly consists of a hood primary lock attached to the radiator cradle tie bar, Fig. 11-9, in the center by three screws and a hood secondary latch release lever, Fig. 11-8, attached to the hood inner panel by two screws into a tapping plate. Tighten primary latch screws to 30 foot-pounds and secondary latch screws to 18 foot-pounds.



Fig. 11-8 Hood Release Lever

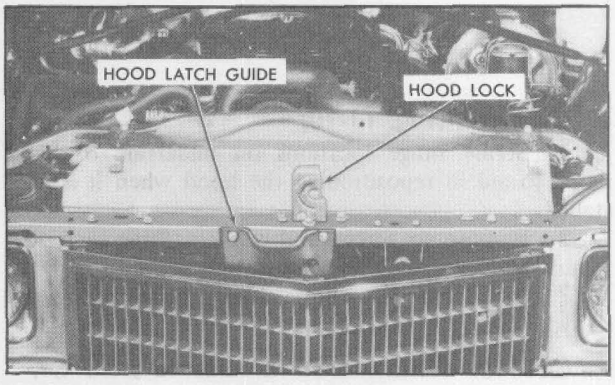


Fig. 11-9 Hood Lock

CAUTION: These hood latch assembly fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with equivalent parts if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

The striker plate in the hood panel is large enough to take care of any fore and aft adjustment necessary. Cross car adjustment only, is provided at the hood lock mounting. Up and down adjustment is provided in the lock itself which has an automatic take up latch.

When the hood latch assembly has been removed, the mounting screws loosened, or the hood adjustment changed, make certain that proper alignment has been obtained before tightening the mounting screws. Failure to do so may result in damage to the latching assembly and/or excessive release handle efforts due to misalignment when the hood is closed.

The following procedure is recommended for checking 1972 model hood latch adjustments:

a. Drop hood from a height of 6 to 8 inches above closed position. The latch must engage.

b. The latch must release when release handle is pulled without lifting the hood.

Hood latches that do not engage or release properly must be corrected by proper adjustment of the hood latch and the hood adjustable bumpers. These adjustments are also used to bring the hood flush with the fenders.

c. Lower hood slowly until the striker plate rests on the latch. With hood in this position, secondary latch must be engaged under hood latch tie bar on radiator cradle, and must have a clearance of .24" maximum between latch hook and tie bar. Modeling clay on this latch can be used to help determine the dimension.

Secondary latches that do not meet these requirements must be adjusted by repositioning the secondary latch on the hood assembly.

d. Both primary and secondary latches must be free of excess friction or binding when operated.

9. Hood Panel

a. Removal (Fig. 11-10)

1. Scribe hinge locations on underside of hood panel to aid in repositioning the hood when it is reinstalled.

2. Remove six screws and washers, three each side, retaining hinge assemblies to hood panel.

3. Remove hood with the aid of a helper, using care to avoid damaging finish.

CAUTION: When hood is removed from car, never stand it upright on rear corners nose up. Hood must be positioned so that it rests on its side; otherwise, damage to sheet metal may result.

b. Installation (Fig. 11-10)

(NOTE: Install an exhaust manifold stud in center holes of hood retaining plate to help locate and position adjusting screws when installing hood.)

1. With the aid of a helper, place hood in position on hood hinge assemblies and loosely install three screws and washers at each hinge assembly.

2. Position hood so that hinges line up with scribe marks and tighten screws at each hinge.

3. Carefully close hood and check alignment of hood at fender and grille opening.

4. Align hood, if necessary, as described in Note 10.

5. Adjust hood latch mechanism as described in Note 8.

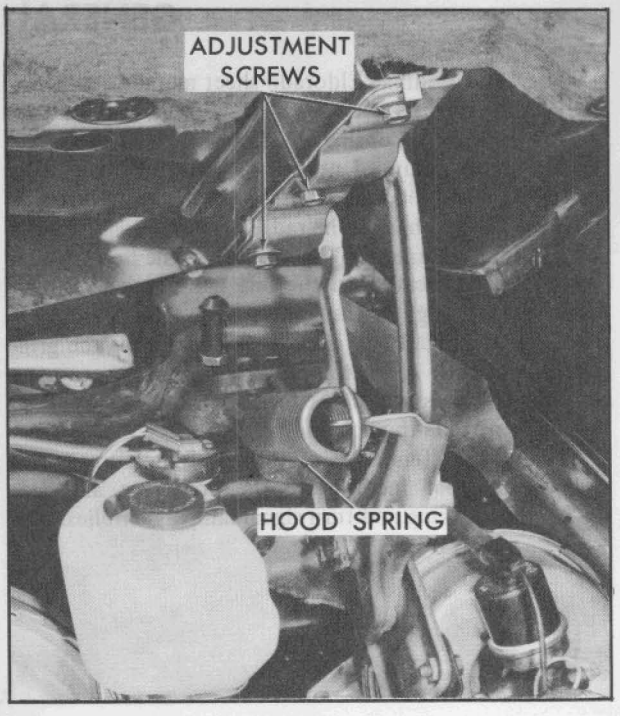


Fig. 11-10 Hood Hinge

10. Hood Adjustment

1. Loosen hood attaching screws, three at each hood hinge, Fig. 11-10. Elongated holes in hinge provide fore, aft, and side adjustment of hood. Position hood so that tolerances shown in Fig. 11-12 are provided.

2. Tighten hinge to hood attaching screws on both sides.

3. Adjust rubber bumpers, located on the tie bar, so that hood panel is flush with fenders at this point.

4. Adjust hood latch mechanism as described in Note 8.

11. Hood Hinge Spring

a. Removal (Fig. 11-10)

1. Open hood and prop as high as possible.

2. Using a strong wire hook, attach one end to center of pry bar of sufficient length and the other end to hinge spring.

3. With the aid of a helper, lift pry bar until spring disengages from hood hinge, then release pressure on bar slowly until spring is loose, then unhook other end of spring from hinge.

b. Installation (Fig. 11-10)

1. Hook one end of spring on hinge, then with the aid of a helper, use pry bar and wire hook to connect spring to front of hinge.

2. Remove prop and close hood.

12. Front Fender (Right or Left) 693

a. Removal (Fig. 11-11)

1. If left fender is to be removed, disconnect negative battery cable. If right fender is to be removed, remove battery.

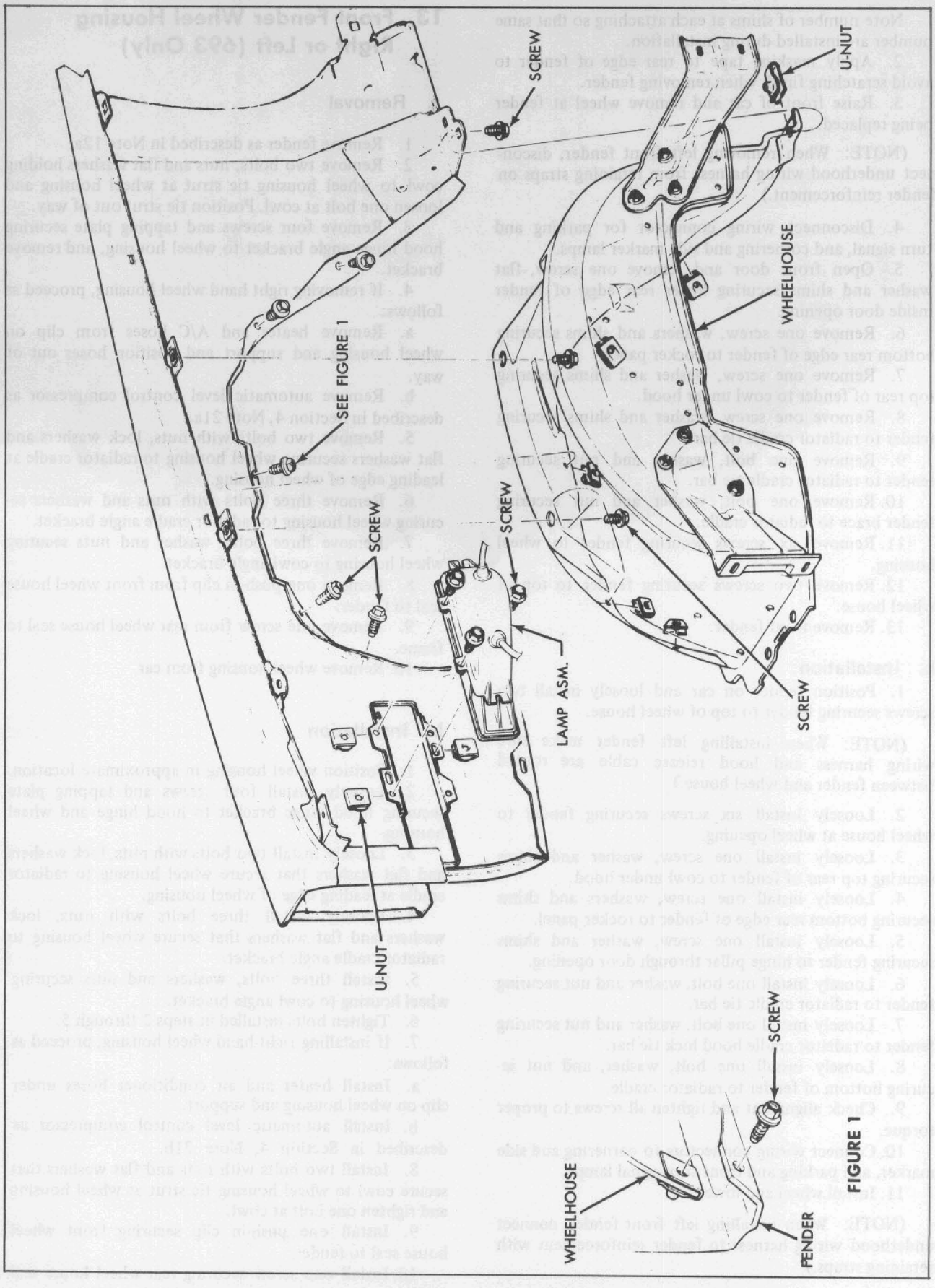


Fig. 11-11 Front Fender Disassembled

Note number of shims at each attaching so that same number are installed during installation.

2. Apply masking tape to rear edge of fender to avoid scratching finish when removing fender.

3. Raise front of car and remove wheel at fender being replaced.

(NOTE: When removing left front fender, disconnect underhood wiring harness from retaining straps on fender reinforcement.)

4. Disconnect wiring connector for parking and turn signal, and cornering and side marker lamps.

5. Open front door and remove one screw, flat washer and shims securing lower rear edge of fender inside door opening.

6. Remove one screw, washers and shims securing bottom rear edge of fender to rocker panel.

7. Remove one screw, washer and shims securing top rear of fender to cowl under hood.

8. Remove one screw, washer and shims securing fender to radiator cradle tie bar.

9. Remove one bolt, washer and nut securing fender to radiator cradle tie bar.

10. Remove one bolt, washer and nut securing fender brace to radiator cradle.

11. Remove six screws securing fender to wheel housing.

12. Remove two screws securing fender to top of wheel house.

13. Remove front fender.

b. Installation

1. Position fender on car and loosely install two screws securing fender to top of wheel house.

(NOTE: When installing left fender make sure wiring harness and hood release cable are routed between fender and wheel house.)

2. Loosely install six screws securing fender to wheel house at wheel opening.

3. Loosely install one screw, washer and shims securing top rear of fender to cowl under hood.

4. Loosely install one screw, washers and shims securing bottom rear edge of fender to rocker panel.

5. Loosely install one screw, washer and shims securing fender to hinge pillar through door opening.

6. Loosely install one bolt, washer and nut securing fender to radiator cradle tie bar.

7. Loosely install one bolt, washer and nut securing fender to radiator cradle hood lock tie bar.

8. Loosely install one bolt, washer, and nut securing bottom of fender to radiator cradle.

9. Check alignment and tighten all screws to proper torque.

10. Connect wiring connectors to cornering and side marker, and parking and front turn signal lamps.

11. Install wheel and lower car.

(NOTE: When installing left front fender, connect underhood wiring harness to fender reinforcement with retaining straps.)

12. Connect battery cable.

13. Remove masking tape from fender.

13. Front Fender Wheel Housing Right or Left (693 Only)

a. Removal

1. Remove fender as described in Note 12a.

2. Remove two bolts, nuts and flat washers holding cowl to wheel housing tie strut at wheel housing and loosen one bolt at cowl. Position tie strut out of way.

3. Remove four screws and tapping plate securing hood hinge angle bracket to wheel housing, and remove bracket.

4. If removing right hand wheel housing, proceed as follows:

a. Remove heater and A/C hoses from clip on wheel housing and support and position hoses out of way.

b. Remove automatic level control compressor as described in Section 4, Note 21a.

5. Remove two bolts with nuts, lock washers and flat washers securing wheel housing to radiator cradle at leading edge of wheel housing.

6. Remove three bolts with nuts and washers securing wheel housing to radiator cradle angle bracket.

7. Remove three bolts, washer and nuts securing wheel housing to cowl angle bracket.

8. Remove one push-in clip from front wheel house seal to fender.

9. Remove one screw from rear wheel house seal to frame.

10. Remove wheel housing from car.

b. Installation

1. Position wheel housing in approximate location.

2. Loosely install four screws and tapping plate securing hood hinge bracket to hood hinge and wheel housing.

3. Loosely install two bolts with nuts, lock washers and flat washers that secure wheel housing to radiator cradle at leading edge of wheel housing.

4. Loosely install three bolts with nuts, lock washers and flat washers that secure wheel housing to radiator cradle angle bracket.

5. Install three bolts, washers and nuts securing wheel housing to cowl angle bracket.

6. Tighten bolts installed in steps 2 through 5.

7. If installing right hand wheel housing, proceed as follows:

a. Install heater and air conditioner hoses under clip on wheel housing and support.

b. Install automatic level control compressor as described in Section 4, Note 21b.

8. Install two bolts with nuts and flat washers that secure cowl to wheel housing tie strut at wheel housing and tighten one bolt at cowl.

9. Install one push-in clip securing front wheel house seal to fender.

10. Install one screw securing rear wheel house seal to frame.

11. Install fender as described in Note 12b.

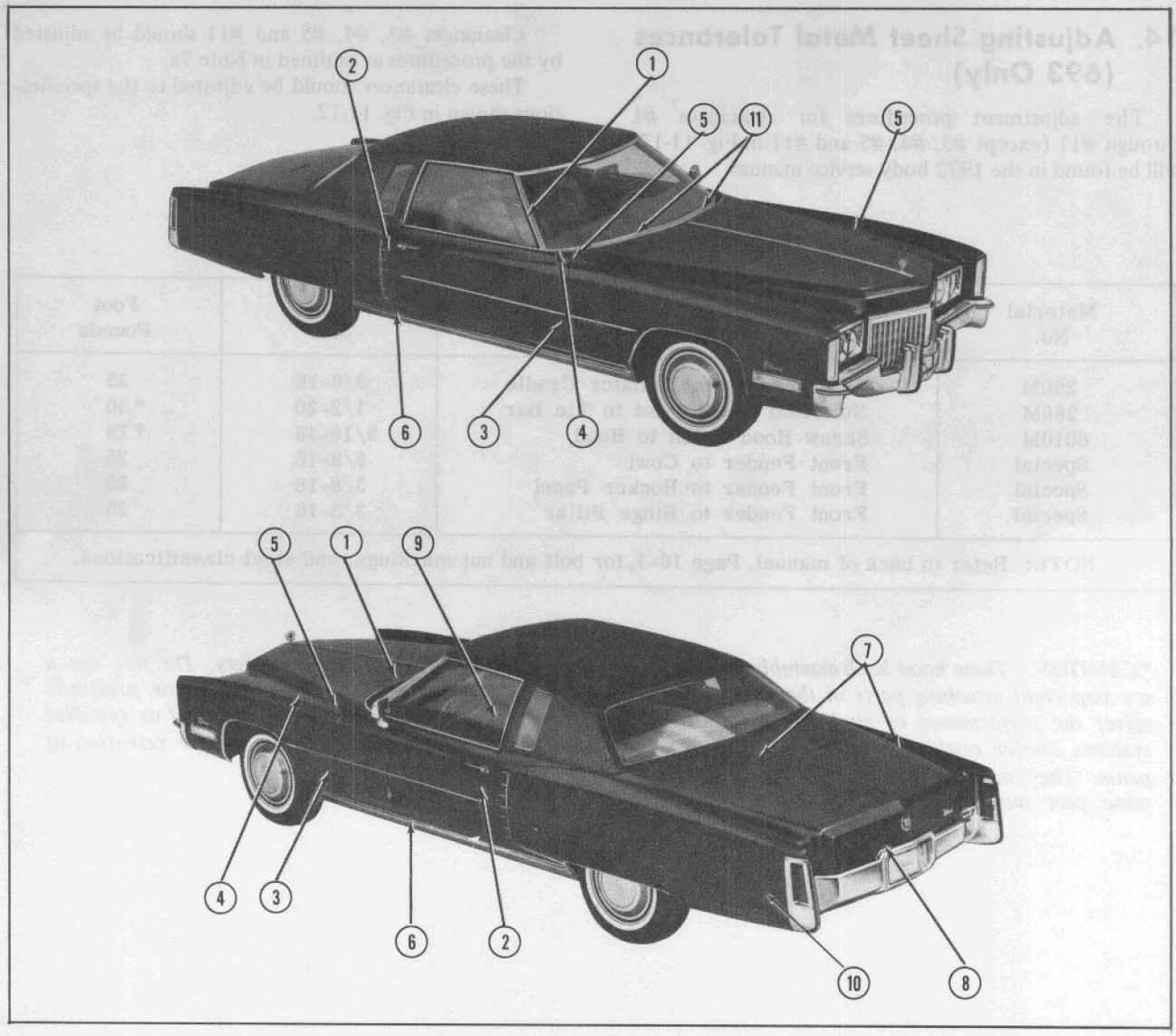


Fig. 11-12 Sheet Metal Tolerances

SHEET METAL TOLERANCES—693

Location	Tolerance"	Flushness
1. Side window to windshield	3/8-7/16	—
2. Door to Quarter Panel	7/32-9/32	± 1/16
3. Door to Fender	1/8-1/4	± 1/16
4. Fender to Hood Panel Rear Extension	1/8-1/4	± 1/16
5. Hood to Fender or Hood Panel Rear Extension	3/32-5/32	± 1/16
6. Door to Rocker Panel	1/8-1/4	—
7. Trunk lid to Fender	1/16-1/4	± 1/16
8. Trunk lid to Bumper	5/16-7/16	—
9. Windows	5/16-3/8	*
10. Rear Bumper to Fender	1/2-3/4	—
11. Hood to Windshield Wiper Arm	1/8 Min.	—

*May be out of plane if weatherstrip provides watertight seal.

14. Adjusting Sheet Metal Tolerances (693 Only)

The adjustment procedures for clearances #1 through #11 (except #3, #4, #5 and #11 in Fig. 11-12) will be found in the 1972 body service manual.

Clearances #3, #4, #5 and #11 should be adjusted by the procedures as outlined in Note 7a.

These clearances should be adjusted to the specifications shown in Fig. 11-12.

TORQUE SPECIFICATIONS—693

Material No.	Application	Size	Foot Pounds
260M	Front Fender to Radiator Cradle	3/8-16	25
286M	Nut-Hood Latch Pilot to Tie Bar	1/2-20	*30
6010M	Screw-Hood Latch to Hood	5/16-18	*18
Special	Front Fender to Cowl	3/8-16	25
Special	Front Fender to Rocker Panel	3/8-16	25
Special	Front Fender to Hinge Pillar	3/8-16	25
NOTE: Refer to back of manual, Page 16-1, for bolt and nut markings, and steel classifications.			

**CAUTION: These hood latch assembly fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with equivalent parts if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

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THEORY OF OPERATION

The vehicle's exterior and interior lighting is controlled by the headlight switch, Fig. 12-1, located on the left side of the instrument panel.

All the exterior lights, except headlights and cornering lights; and all the instrument panel lights come on when the headlight switch control knob is pulled halfway out. Pulling the control knob all the way out turns the headlights on in addition to all the other exterior lights (except cornering lights).

The intensity of the instrument panel lights can be increased, decreased or turned off by rotating the headlight switch control knob.

The headlight circuits are protected by a circuit breaker in the headlight switch. An overload on the circuit breaker will cause the lights to "Flicker" on and off.

The front fender cornering light, front side marker light and reflex assembly is located in the forward lower side of each front fender.

When either turn signal is operating with the headlights or parking lights on, the corresponding cornering light illuminates the side of the road.

Turn signal and parking lights are located between each pair of dual headlights, on either side of the radiator grille except on the Eldorado, where they are located in the nose of the front fenders.

Rear side marker lights and reflex assemblies are located in the rear quarter panel at the side trim molding except on the Eldorado, where they are incorporated in the tail light assemblies.

Dual back-up light assemblies are mounted in the rear bumper center bar, between the license plate and the bumper outer ends, except on the Eldorado, where they are mounted to the bumper on either side of the license plate.

The back-up lights are connected to operate through the neutral safety switch with ignition on. Placing the vehicle shift lever in "reverse", positions the switch so that the back-up lights will turn on both day and night.

Rear tail, stop and signal lights incorporating a rear reflex are housed in the bumper outer ends on all cars except Eldorados. On the Eldorado, individual rear reflexes are mounted at each end of the rear bumper center bar.

Lane-Change Directional Signal Switch

When making a partial turn, such as when changing lanes, the driver has the option of moving the turn signal lever to a detent stop. The signal will continue as long as the lever is held in this position and will cancel automatically when the lever is released. By using the detent position, a shallow turn can be signaled without a possibility of failure to cancel, if the turn is not sharp enough to do it automatically.

Moving the turn signal lever past the detent position to the extreme of its travel for either turn, will provide conventional turn signal operation.

A Hazard Warning Flasher is included in the directional signal switch circuit. The hazard warning system is activated by pushing in on the button Fig. 12-2 located just below the steering wheel on the right side of the steering column. When the system is operating, the turn signal indicator(s) on the instrument cluster will flash simultaneously.

The hazard warning flasher will operate with the ignition in the lock position and the key removed, allowing the car to be locked while help is sought.

(NOTE: If the brake pedal is depressed when the hazard warning flasher is in operation, the lights will not flash but will glow continuously.)

(NOTE: For information pertaining to the Fleetwood Eldorado lighting system, refer to the latter portion of this section.)

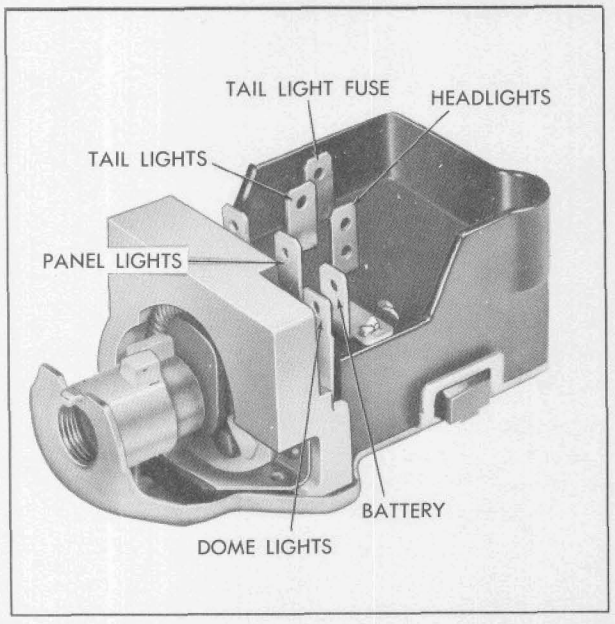


Fig. 12-1 Headlight Switch

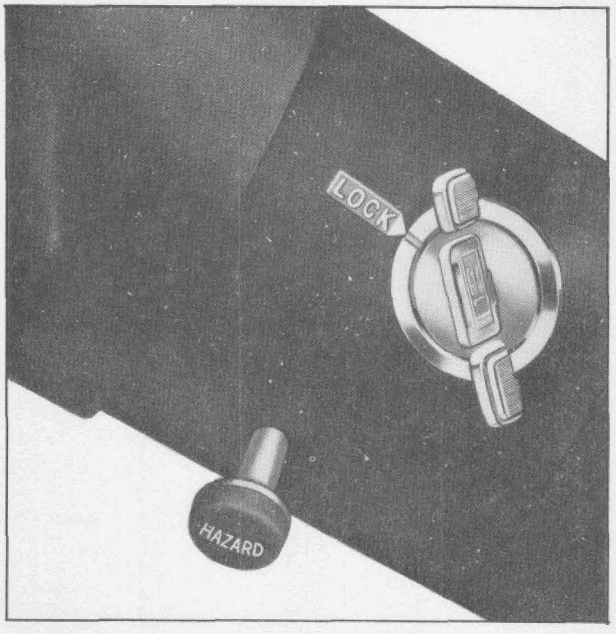


Fig. 12-2 Hazard Warning Flasher Switch

HEADLIGHTS
SERVICE DIAGNOSIS

POSSIBLE CAUSE	CORRECTIVE ACTION
ONE HEADLIGHT INOPERATIVE OR INTERMITTENT	
Loose connection.	Secure connections to sealed beam including ground (black wire).
Defective sealed beam.	Replace.
ONE OR MORE HEADLIGHTS ARE DIM	
Open ground connection at headlight.	Repair black wire connection between sealed beam and body ground.
Black ground wire mislocated in headlight connector (Type 2 Sealed Beam).	Relocate as shown in Service Circuit.
ONE OR MORE HEADLIGHTS – SHORT LIFE	
Voltage regulator misadjusted.	Check and adjust if necessary to specifications in Shop Manual.
ALL HEADLIGHTS INOPERATIVE OR INTERMITTENT	
loose connection.	Check and secure connections at foot switch and light switch and ground wire connections.
Defective foot switch.	Check voltage at foot switch with test bulb. If bulb lights only at light blue wire terminal, replace foot switch.
Open wiring – light switch to foot switch.	Check voltage at light blue wire with test bulb. If bulb lights at light switch light blue wire terminal but not at foot switch, repair open wire.
Open wiring – light switch to battery.	Check voltage at light switch yellow wire terminal with test bulb. If bulb fails to light, repair open yellow wire circuit to battery (possible open fusible link).
Circuit shorted to ground.	If, after a few minutes operation, headlights flicker on and off and/or a thumping noise can be heard from the light switch (circuit breaker opening and closing), repair short to ground in circuit between light switch and headlights. After repairing short, check for headlight flickering after one minute operation. If flickering occurs, the circuit breaker has been damaged and light switch must be replaced.
Defective light switch.	Check voltage at light switch yellow and blue wire terminals with test bulb. If bulb lights at yellow wire terminal but not at light blue, replace light switch.
UPPER OR LOWER BEAM WILL NOT LIGHT OR INTERMITTENT	
Open connection or defective foot switch.	Check voltage at foot switch headlight terminals with test light. If bulb lights at headlight terminals (light green - U.B., Tan - L.B.), repair open wiring between foot switch and headlights. If bulb will not light at one of the foot switch headlight terminals, replace foot switch.
Circuit shorted to ground.	Follow diagnosis shown above under "All Headlights Inoperative or Intermittent."
Defective sealed beam.	Replace.

TURN SIGNAL AND HAZARD WARNING LAMPS SERVICE DIAGNOSIS

TURN SIGNAL INOPERATIVE – ONE SIDE

POSSIBLE CAUSE	CORRECTIVE ACTION
Bulb out (flasher cannot be heard).	Turn on hazard warning system. If one or more lamps do not operate, check for defective bulb.
Open wiring or ground connection.	Turn on hazard warning system. If one or more bulbs do not operate, use 12 volt test lamp to check voltage at lamp socket. If test bulb lights, repair open ground connection. If not, repair open wiring between bulb socket and turn signal switch.
Improper bulb or defective turn signal switch.	Turn on hazard warning system. If all front and rear lamps operate, check for improper bulb (should be 1157). If bulbs are OK, replace defective turn signal switch.
Short to ground (flasher can be heard, but no lamps operate).	Locate and repair short to ground by disconnecting front and rear circuits separately.

TURN SIGNALS INOPERATIVE – BOTH SIDES

Open fuse (turn signal).	Turn on hazard warning system. If all lamps operate, replace turn signal fuse if blown. If new fuse blows, repair short to ground between fuse and lamps.
Defective flasher (located behind instrument panel near steering column).	If turn signal fuse is OK, and hazard warning system will operate lamps, replace defective turn signal flasher (behind instrument panel near steering column).
Loose connection.	Secure steering column connector. If test bulb lights only on one side of purple wire terminals in connector, clean or tighten connector contacts.
Open wiring or defective turn signal switch.	If test bulb lights when connected to both sides of purple wire connection in steering column connector, replace defective turn signal switch. If test bulb does not light on either side of the connector, repair open circuit between fuse and connector.

HAZARD WARNING LAMPS INOPERATIVE

Open fuse (stop-hazard).	Switch on turn signals. If lamps operate, replace stop-hazard fuse if blown. If new fuse blows, repair short to ground. (Could possibly be in stop light circuit.)
Defective flasher (located on fuse panel).	If stop-hazard fuse is OK, switch on turn signals. If lamps operate, replace defective hazard flasher (on fuse panel).
Open wiring or defective turn signal switch.	With 12 volt test bulb, check voltage at brown wire in turn signal steering column connector. If test bulb does not light on either side of connector, repair open circuit between flasher and connector. If test bulb lights only on feed side of connector, clean connector contacts. If test bulb lights on both sides of connector, replace defective turn signal switch assembly.

CORNERING LAMPS SERVICE DIAGNOSIS

ONE LAMP INOPERATIVE

POSSIBLE CAUSE	CORRECTIVE ACTION
Loose connection.	Secure connector near lamp.
Bulb out.	Replace burned out bulb.
Open ground connection.	If bulb is known good and test bulb lights at connector near lamp, repair open ground connection through lamp mounting.
Open wiring.	If test bulb lights on both sides of steering column connector, repair open wiring between connector and lamps. If not, check for open connection in connector.
Defective directional signal switch.	If test bulb lights at brown wire terminals of steering column connector but not at gray (left turn) or black/white (right turn) terminal, replace directional signal switch.

BOTH LAMPS INOPERATIVE

Tail fuse blown.	If tail lamps do not light, replace tail fuse if blown. If new fuse blows, repair short to ground between fuse and lamps.
Cornering-park lamp fuse blown.	If the cornering and park lamps do not light, and the tail lamps do light, replace cornering and park lamp fuse. If new fuse blows, repair short to ground between fuse and lamps.
Loose connection.	Secure connectors at light switch and steering column.
Open wiring.	If tail lamps light, check voltage at steering column connector brown wire. If test bulb lights on lamp side of connector only, repair terminal. If tail lamps do not light, check for open wiring between light switch and battery.
Defective directional signal switch.	If tail lamps light, and test bulb lights on both sides of steering column connector, replace directional signal switch.
Defective light switch.	If tail lamps do not light and test bulb lights at light switch terminal #5 but not at #4, replace light switch.

SIDE MARKER LAMPS SERVICE DIAGNOSIS

POSSIBLE CAUSE	CORRECTIVE ACTION
ONE LAMP INOPERATIVE	
Side marker bulb out.	Replace burned out bulb.
Loose connection or open wiring.	Check voltage at bulb socket brown wire terminal with test bulb. If bulb lights, repair open ground circuit. If bulb does not light, repair open brown wire circuit.
FRONT OR REAR LAMPS INOPERATIVE	
Loose connection or open ground connection.	If associated tail or park lamps do not operate, secure all connectors in brown wire circuit. If park lamps operate, repair open ground connections through lamp mounting.
Multiple bulbs out.	Replace burned out bulbs.
ALL LAMPS INOPERATIVE	
Tail lamp fuse blown.	If park and tail lamps do not operate, replace tail fuse if blown. If new fuse blows, check for short to ground between fuse panel and lamps.
Cornering-park lamp fuse blown.	If the side marker and park lamps do not light, and tail lamps do light, replace cornering and park lamp fuse. If new fuse blows, repair short to ground between fuse and lamps.
Loose connection.	Secure connector to light switch.
Open wiring.	Check voltage at tail fuse with test bulb. If bulb lights, repair open wiring between fuse and light switch. If not, repair open wiring between fuse and battery. (Possible open fusible link.)
Defective light switch.	If test bulb lights at light switch terminal #5 but not at terminal #4, replace light switch.

TAIL, PARK AND LICENSE LAMPS SERVICE DIAGNOSIS

POSSIBLE CAUSE	CORRECTIVE ACTION
ONE SIDE INOPERATIVE	
Bulb out.	Replace.
Open ground connection at bulb socket or ground.	Jumper bulb base socket connection to ground. If lamp lights, repair open ground circuit through lamp mounting.
BOTH SIDES INOPERATIVE	
Tail lamp fuse blown.	Replace fuse. If new fuse blows, repair short to ground in brown wire circuit between fuse panel through light switch to lamps.
Cornering-park lamp fuse blown.	If the park lamps do not light and the tail lamps do light, replace cornering-park lamp fuse. If new fuse blows, repair short to ground between fuse and lamps.
Loose connection.	Secure connector at light switch.
Open wiring.	If test bulb does not light on either side of fuse, repair open circuit between fuse panel and battery. (Possible open fusible link.) If test bulb lights at light switch brown wire terminal (5), repair open wiring between light switch and lamps.
Multiple bulb burnout.	If test bulb lights at lamp socket brown wire terminal, replace bulbs.
Defective light switch.	*If test bulb lights at light switch terminal #4 (light green/black) but not at terminal #5 (dark green), replace defective light switch.

STOP LAMPS
SERVICE DIAGNOSIS

POSSIBLE CAUSE	CORRECTIVE ACTION
ONE BULB INOPERATIVE	
Bulb out.	Replace bulb.
ONE SIDE INOPERATIVE	
Loose connection, open wiring or defective bulbs.	Turn on directional signal. If lamp does not operate, check bulbs. If bulbs are OK, secure all connections. If lamp still does not operate, check for open wiring with a test bulb.
Defective directional signal switch or cancelling cam.	If lamp will operate by turning on directional signal, the switch is not centering properly during cancelling operation. Replace defective cancelling cam or directional signal switch.
ALL INOPERATIVE	
Stop-hazard fuse blown.	Replace. If new fuse blows, repair short to ground in circuit between fuse and lamps.
Stop switch misadjusted or defective.	With test bulb check voltage with brake pedal depressed at white wire terminal in steering column connector. If bulb does not light, check stop switch for proper adjustment. If adjustment is OK, replace stop switch.
WILL NOT TURN OFF	
Stop switch misadjusted or defective.	Readjust properly. If switch still malfunctions, replace.

BACK-UP LAMPS SERVICE DIAGNOSIS

ONE LAMP INOPERATIVE OR INTERMITTENT

POSSIBLE CAUSE	CORRECTIVE ACTION
Open ground connection.	Repair bulb ground through lamp mounting.
Loose connection.	Tighten connectors.
Bulb out.	Replace bulb.

BOTH LAMPS INOPERATIVE OR INTERMITTENT

Fuse blown.	Replace fuse. If new fuse blows, repair short to ground in circuit from fuse through neutral-safety switch to back-up lamps.
Loose connection or open circuit.	Secure all connectors. If OK, check continuity by voltage checking circuit from fuse to lamps with test bulb. If test bulb does not light on either side of fuse, check for open circuit from ignition switch to fuse.
Neutral-safety switch misadjusted (open when shift lever is in reverse position).	Adjust.
Defective neutral-safety switch.	With ignition on, check voltage at terminals with switch in back-up position. If bulb lights at pink wire terminal but not at light green wire terminal, replace neutral-safety switch.
Defective ignition switch.	If test bulb lights at ignition switch battery terminal but not at output terminal, replace ignition switch.

LAMPS WILL NOT TURN OFF

Neutral-safety switch misadjusted (closed when shift lever is not in reverse position).	Adjust.

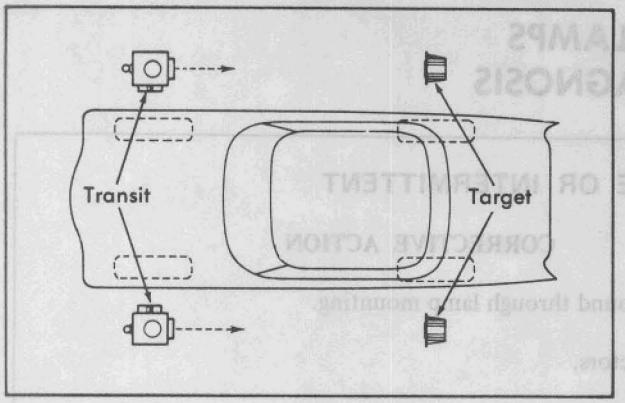


Fig. 12-3 Selecting an Aiming Area

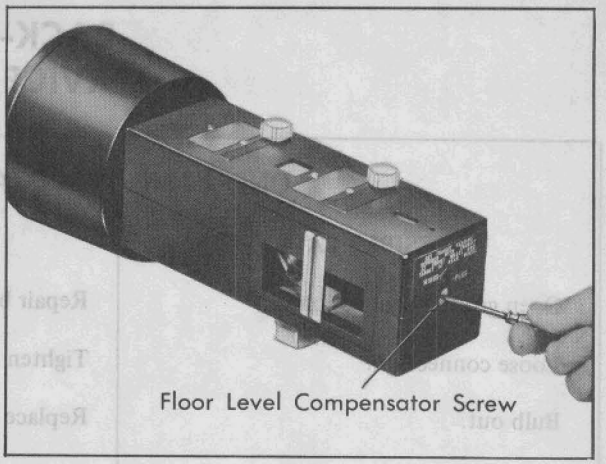


Fig. 12-5 Adjusting Floor Level Compensator

1. Headlight Aiming—Mechanical Aimer Method

a. Adjusting Aimer for Floor Level

(NOTE: To obtain accurate headlight aim, the car must be placed on a flat surface.)

1. Drive car on selected area and place transit target at rear wheel on either side of car Fig. 12-3.
2. Place transit at front wheel on same side so target is visible, Fig. 12-3.
3. Adjust screw on back of transit until split image is aligned, Fig. 12-4.
4. Turn dial on side of transit until bubble is centered in level vial, Fig. 12-4.
5. Turn floor level compensator on both aimers with screwdriver until adjoining dial reads same as dial on transit, Fig. 12-5.

(NOTE: Aimers must have floor level compensator readjusted for each new location if floor levels are different.)

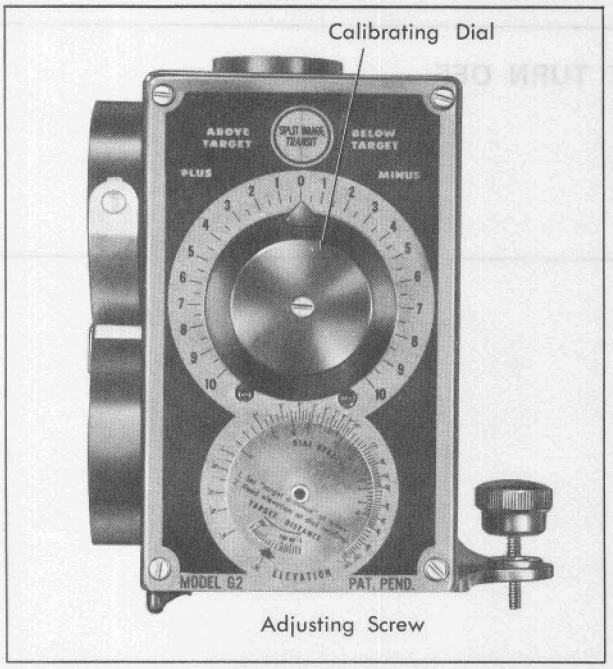


Fig. 12-4 Adjusting Transit

b. Headlight Adjustment

1. Equalize tire pressure as recommended in Section 10, Fig. 10-1, and make certain car is at normal front standing height: Section 3, Note 1 on all but 693 style and Note 19 on 693 style. Make certain car is at normal rear standing height, Section 4, Note 1.
2. Turn on headlight units to make sure none are burned out. All four units should be on for high beam and only the two outer units should be on for low beam. Turn lights off for adjustment.
3. Clean headlight lens. Position aimers on outer headlights. Guide points must engage smooth inner ring of aimer at alignment points, Fig. 12-6 and the "sight" openings on each aimer must point toward center of car.
4. Secure aimer to each headlight by pressing handle "Y" forward until vacuum cup engages headlight lens, then draw handle back until spring catches, Fig. 12-7.

c. Horizontal Headlight Aiming:

1. Set "Right - Left" dial on zero, Fig. 12-8.

(NOTE: It is not necessary to remove the headlight bezels. The horizontal and vertical adjusting screws are accessible with the bezels in place.)

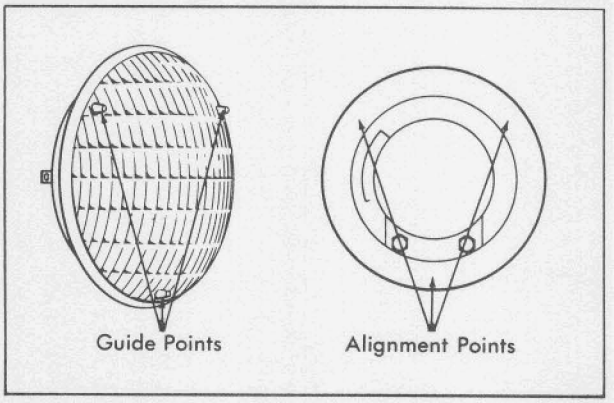


Fig. 12-6 Installing Aimers on Sealed Beam

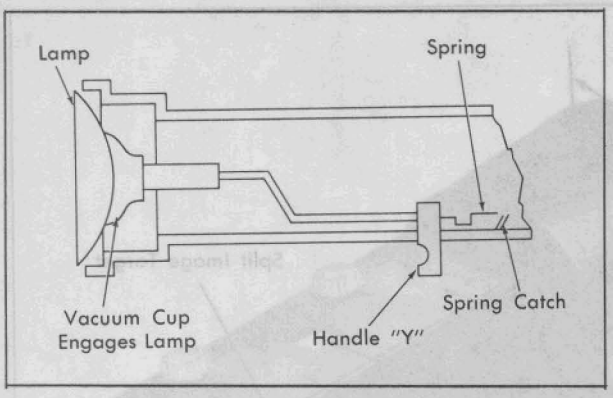


Fig. 12-7 Securing Aimers on Sealed Beams

2. Check split image in viewing port. Rotate aimer slightly if necessary to locate target.

3. If split images are aligned, horizontal aim is correct.

4. If images are not aligned, turn horizontal adjusting screw until split images align. Final adjustment should be made by turning screw in a clockwise direction to remove backlash.

d. Vertical Headlight Aiming

1. With equipment in place turn knob at "Down-Up" dial until pointer is at zero on both aimers.

(NOTE: Individual State laws may vary and dealers should check with local authorities on the regulations of your State.)

2. Turn headlight vertical aiming screw counterclockwise until bubble is on car side of center. Turn screw clockwise until bubble is centered for correct aim and elimination of backlash, Fig. 12-8. Repeat horizontal and vertical adjustments on other headlight aimer.

3. Recheck target alignment on each side and readjust horizontal aim if necessary.

4. Hold aimer and release spring catch, Fig. 12-7. Push handle toward headlight to release aimer.

5. Repeat horizontal and vertical adjustments on inner set of headlights.

e. Calibrating Aiming Fixture

Aimer, J-6878-01, is calibrated by the manufacturer for use on a level floor. These aimers require no further change in calibration unless they are dropped or damaged in some manner.

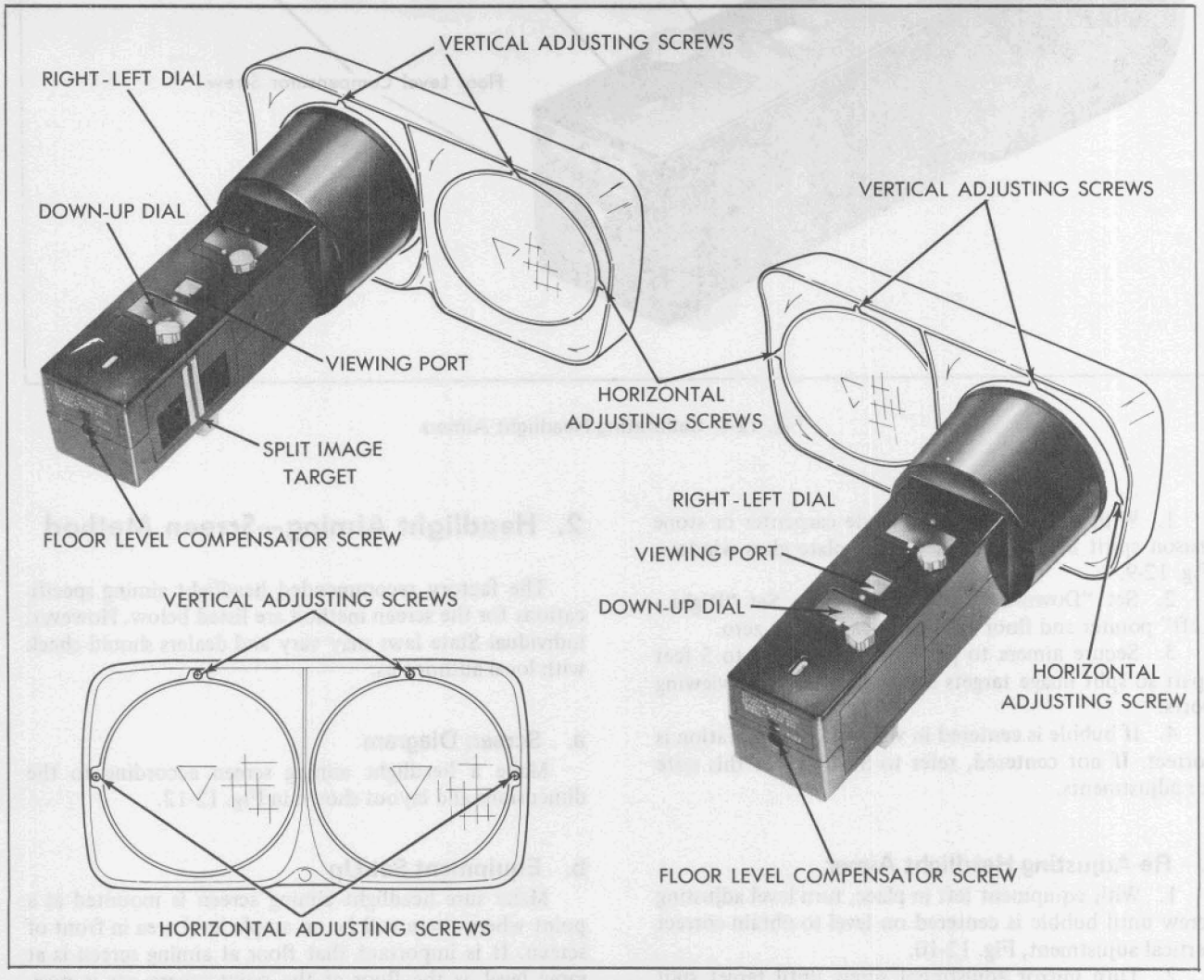


Fig. 12-8 Horizontal and Vertical Adjustments

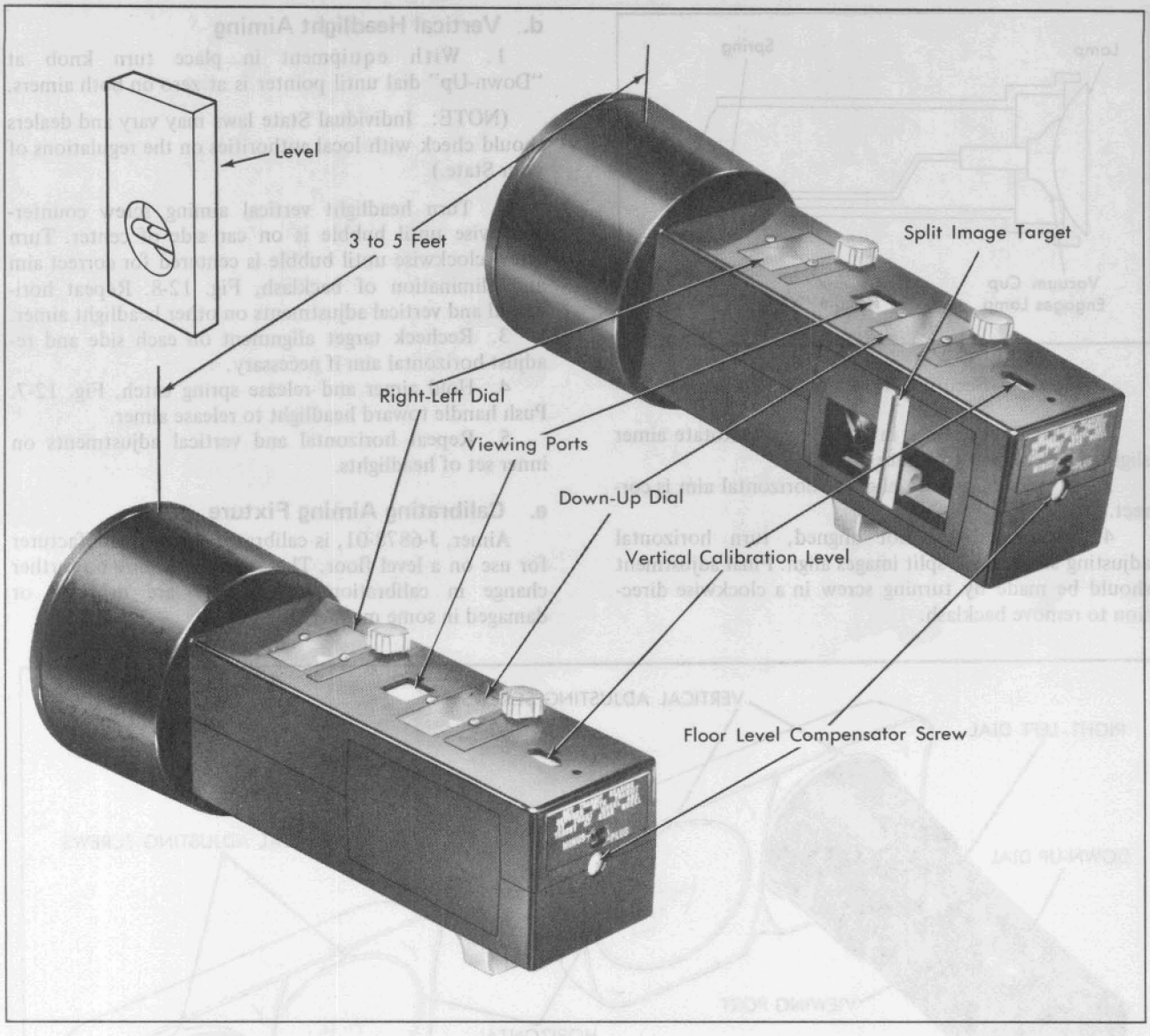


Fig. 12-9 Calibrating Headlight Aimers

1. With the aid of a good grade carpenter or stone mason spirit level, locate a vertical plate glass window, Fig. 12-9.

2. Set "Down-Up" pointer on zero. Set "Right - Left" pointer and floor level compensator on zero.

3. Secure aimers to plate glass window 3 to 5 feet apart so split image targets can be located in the viewing ports.

4. If bubble is centered in vial, vertical calibration is correct. If not centered, refer to Section f of this note for adjustments.

f. Re-Adjusting Headlight Aimer

1. With equipment left in place, turn level adjusting screw until bubble is centered on level to obtain correct vertical adjustment, Fig. 12-10.

2. Turn mirror adjustment screw until target split image becomes aligned, Fig. 12-11.

2. Headlight Aiming—Screen Method

The factory recommended headlight aiming specifications for the screen method are listed below. However, individual State laws may vary and dealers should check with local authorities.

a. Screen Diagram

Make a headlight aiming screen according to the dimensions and layout shown in Fig. 12-12.

b. Equipment Set-Up

Make sure headlight aiming screen is mounted at a point where there will be an ample level area in front of screen. It is important that floor at aiming screen is at same level as the floor at the point where car is positioned.



Fig. 12-10 Readjusting Vertical Calibration



Fig. 12-11 Readjusting Horizontal Calibration

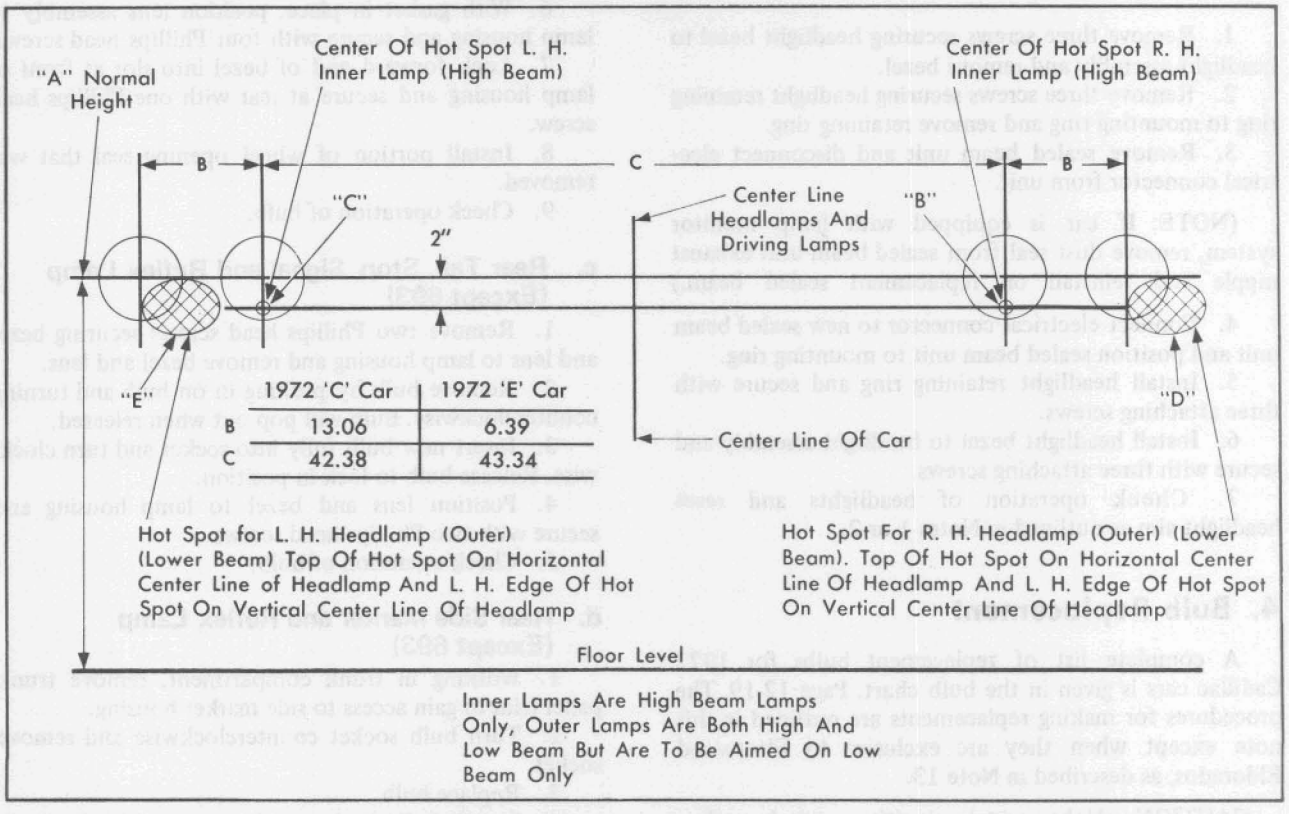
c. Headlight Aiming Adjustment

1. Position car so that headlights are exactly 25 feet from aiming screen and car is in line with centerline on screen. To position car, sight through rear window, lining up centerline of rear window reveal molding escutcheon with inside rear view mirror bracket and car centerline on screen.

2. Position two 36 inch sticks vertically at the left front and left rear wheels. Sight over sticks and move left side of screen up or down, as required, to line up horizontal headlight centerline on screen with the 36 inch sight line. Follow same procedure on right side.

3. Mark wall adjacent to horizontal centerline of headlight line on aiming screen. Subtract the curb height from 36. Using the new dimension, mark down on the wall from the 36 inch mark.

Move screen down until horizontal centerline of headlight is even with this point.



	1972 'C' Car	1972 'E' Car
B	13.06	6.39
C	42.38	43.34

Fig. 12-12 Headlight Aiming Screen

Series	Rear Suspension	Curb Height @ ℄ Headlamps
681	All	26.66"
682	Std.	26.52"
	A.L.C.	26.55"
697	All	27.61"
693	All	27.35"
698	All	28.26"

4. Set headlights on high beam. Make sure all four headlights are on.

5. Cover both left side headlights and right side outer light and adjust right inner light as required until hot spot centers at point "B" on screen, Fig. 12-12.

6. Cover both right side headlights and left side outer light and adjust left inner light as required until hot spot centers at point "C" on screen, Fig. 12-12.

7. Set headlight on low beam. Only outer headlights should light.

8. Cover left outer headlight and adjust right outer light as required until top of hot spot "D" is on horizontal centerline of headlight and left edge of hot spot is on vertical centerline of outer light, Fig. 12-12.

9. Cover right outer headlight and adjust left outer light as required until top of hot spot "E" is on horizontal centerline of headlight and left edge of hot spot is on vertical center line of outer light, Fig. 12-12.

3. Sealed Beam Unit Replacement

1. Remove three screws securing headlight bezel to headlight assembly and remove bezel.

2. Remove three screws securing headlight retaining ring to mounting ring and remove retaining ring.

3. Remove sealed beam unit and disconnect electrical connector from unit.

(NOTE: If car is equipped with lamp monitor system, remove dust seal from sealed beam unit exhaust nipple and reinstall on replacement sealed beam.)

4. Connect electrical connector to new sealed beam unit and position sealed beam unit to mounting ring.

5. Install headlight retaining ring and secure with three attaching screws.

6. Install headlight bezel to headlight assembly and secure with three attaching screws.

7. Check operation of headlights and reset headlight aim as outlined in Notes 1 or 2.

4. Bulb Replacement

A complete list of replacement bulbs for 1972 Cadillac cars is given in the bulb chart. Page 12-19. The procedures for making replacements are outlined in this note except when they are exclusive to Fleetwood Eldorados, as described in Note 13.

CAUTION: Make certain ignition switch and headlight switch are off when replacing bulbs.

a. Front Parking and Turn Signal Lamp (Except 693)

1. Remove one screw securing top of bezel to housing, pull forward and unhook bottom of bezel from housing.

2. Remove two screws, one at top and bottom, securing lens to lamp and remove lens.

3. Push bulb deeper into socket, turn counterclockwise and release. Bulb will spring out.

4. Insert new bulb fully into socket and turn clockwise. Release bulb to lock in position.

5. Position lens to lamp and secure with two screws.

6. Engage lower locking tabs on bezel to housing and push top portion into position. Secure with one screw.

7. Check operation of bulb.

b. Front, Cornering, Side Marker and Side Reflex (Except 693)

1. Partially remove wheel opening seal to gain access to lamp housing.

2. Remove one Phillips head screw securing rear of bezel to lamp and remove bezel by pulling rearward and rotating outward.

3. Remove four Phillips head screws securing lens assembly to lamp and remove lens assembly.

4. To remove either park and signal or cornering lamp bulb, push in on bulb and turn counterclockwise. Bulb will pop out when released.

5. Install one or both bulbs as necessary by inserting fully into socket and turning clockwise. Release bulb to lock in position.

6. With gasket in place, position lens assembly to lamp housing and secure with four Phillips head screws.

7. Lock forward end of bezel into slot at front of lamp housing and secure at rear with one Phillips head screw.

8. Install portion of wheel opening seal that was removed.

9. Check operation of bulb.

c. Rear Tail, Stop, Signal and Reflex Lamp (Except 693)

1. Remove two Phillips head screws securing bezel and lens to lamp housing and remove bezel and lens.

2. Remove bulb by pushing in on bulb and turning counterclockwise. Bulb will pop out when released.

3. Insert new bulb fully into socket and turn clockwise. Release bulb to lock-in position.

4. Position lens and bezel to lamp housing and secure with two Phillips head screws.

5. Check operation of bulb.

d. Rear Side Marker and Reflex Lamp (Except 693)

1. Working in trunk compartment, remove trunk panel trim to gain access to side marker housing.

2. Turn bulb socket counterclockwise and remove socket.

3. Replace bulb.

4. Install bulb socket and secure with clockwise turn.

5. Replace trunk panel trim and close compartment lid.

e. License Plate Lamp

1. Remove two Phillips head screws securing lens to housing and remove lens.
2. Replace bulb.
3. Install lens with two Phillip head screws and check operation of bulb.

f. Instrument Panel Courtesy Lamps

1. Reach under dash and snap socket and bulb out of housing.
2. Remove bulb from socket and replace.
3. Snap socket and bulb into housing.

g. Map Lamp

1. Remove two screws securing map lamp assembly.
2. Pull assembly out at the top and remove.
   a. Switch lever must be in "ON" position for proper removal clearance.
3. Remove bulb from socket and replace bulb.
4. Install assembly and secure with two screws.

h. Instrument Panel Lamps

1. Remove switch panel on right side of instrument panel cluster.
   a. In extreme cases it may be necessary to remove instrument panel top cover as described in Note 40.
2. Replace bulb in back of cluster.
3. Install switch panel.

i. Automatic Climate Control or Heater Panel Lamp

1. Remove steering column lower cover as described in Note 41a.
2. Remove socket from housing and remove bulb from socket.
3. Install new bulb into socket and replace socket in housing.
4. Install steering column lower cover as described in Note 41b.

j. Radio Receiver Dial Lamp

(AM/FM, AM/FM signal seeking stereo, and AM/FM signal seeking stereo remote control.)

1. Remove switch panel on right side of instrument panel cluster.
2. Reach down on top of radio and snap socket out of top center of receiver unit.
3. Install new bulb and snap socket into radio receiver.
4. Install switch panel.

k. Radio Receiver Dial Lamp

(AM/FM Stereo/Tape)

1. Lift tape access door.
2. Reach in and rotate down bulb/socket assembly.
3. Install new bulb and rotate bulb/socket assembly fully up.

l. Headlight Switch Dial Lamp

1. Remove steering column lower cover as described in Note 41a.
2. Pull upper or lower socket from housing and remove bulb.
3. Install new bulb and snap socket into housing.
4. Install steering column lower cover as described in Note 41b.

m. Ash Tray Lamp

1. Remove ash tray receptacle.
2. , Remove bulb socket from shield, replace bulb and install socket.
3. Insert ash tray receptacle in ash tray housing.

n. Glove Box Lamp

Open glove box door and replace bulb located just above top center of door opening.

o. Clock Lamp

1. Reach up through top of glove box and remove bulb sockets.
2. Replace either bulb.
3. Install bulb sockets through top of glove box.

p. Cruise Control Switch Lamp

1. Remove steering column lower cover as described in Note 41a.
2. Snap socket and bulb from selector assembly and replace bulb.
3. Install steering column lower cover as described in Note 41b.

q. Trunk Lamp

Open trunk lid and replace bulb located in rear area of trunk lid.

r. Rear Window DeFogger Indicator Lamp

1. Remove switch panel on right side of instrument panel cluster.

(NOTE: Panel is held in place by spring clips and pulls out.)

2. Remove indicator lamp socket from switch.
3. Replace bulb.
4. Install lamp socket in switch.
5. Install switch panel.

5. Headlight Housing Assembly (Except 693)

a. Removal

1. Disconnect Negative battery cable at battery.

(NOTE: If working on right side of car, battery must be removed as described in Section 6, Note 19.)

2. Disconnect electrical and lamp monitor connector if so equipped, from sealed beams and parking lamp.
3. Remove three screws securing outer headlamp bezel to headlamp housing and remove bezel.

4. Remove one screw, located behind bezel removed in Step 3, securing headlamp housing to front fender.

5. Remove two screws securing top of headlamp housing to radiator cradle and two screws at bottom.

6. Remove headlamp housing, being careful not to lose shims in area of mounting screws.

b. Installation

1. Connect electrical and lamp monitor connector, if so equipped to sealed beams and parking lamp.

2. Position headlamp housing to car and loosely install one screw securing housing to front fender.

3. Install four mounting screws loosely. Add sufficient shims to align headlamp housing properly and tighten all screws.

4. Position bezel to outer headlamp and secure with three screws.

5. Install battery if removed. Connect negative battery cable and check operation of lamps and lamp monitor, if so equipped.

6. Reset headlight aim as outlined in Notes 1 or 2.

6. Front Parking and Signal Lamp Assembly (Except 693)

a. Removal

1. Disconnect negative battery cable at battery.

(NOTE: If working on right side of car, battery must be removed as described in Section 6, Note 19.)

2. Disconnect wiring and monitor connections, if so equipped, from lamp.

3. Remove two bolts, one each side of lamp, securing lamp to housing and remove lamp.

b. Installation

1. Position lamp to housing and secure with two bolts, one each side of lamp.

2. Route wiring and connect wiring and monitor connections, if so equipped.

(NOTE: Install battery if previously removed.)

3. Connect negative battery cable at battery and check operation of lamp.

7. Front Cornering and Side Marker Lamp Assembly (Except 693)

a. Removal

1. Raise hood.

2. Disconnect negative battery cable at battery.

(NOTE: If working on right side of car, battery must be removed as described in Section 6, Note 19.)

3. Disconnect lamp wiring connector.

4. Remove lens assembly as outlined in Note 4b.

5. Working through engine compartment, remove two bolts with lock washers securing lamp to upper mounting bracket.

6. Remove one bolt with lock washer securing lamp to lower mounting bracket.

7. Loosen bolt securing lower mounting bracket to radiator cradle and move bracket out of way.

8. Slide lamp rearward and remove from car.

b. Installation

1. Install lamp on car and position lower mounting bracket to lamp.

2. Install bolt with lock washer loosely securing lamp to radiator cradle lower mounting bracket.

3. Loosely install two bolts with lock washers securing lamp to upper mounting bracket.

4. Install lens assembly as outlined in Note 4b.

5. Align lamp and tighten mounting bolts.

6. Connect lamp wiring to mating connector.

7. Install battery. Connect negative battery cable and check operation.

8. Rear Tail, Stop, Signal and Reflex Lamp Assembly (Except 693)

a. Removal

1. Disconnect negative battery cable at battery.

2. Remove rear bumper from car as outlined in Section 14, Note 5a.

3. Remove bezel and lens as outlined in Note 4C.

4. Remove upper mounting rubber bumper from upper mounting bolt and remove nut and flat washer securing lamp to bumper outer end.

5. Remove lamp lower mounting bolt and flat washer securing lamp to bumper end and remove lamp.

b. Installation

1. Position lamp housing to rear bumper with square hole in housing upward.

2. Loosely install bolt and flat washer securing lower end of lamp.

3. Loosely install one flat washer and nut securing upper end of lamp housing.

4. Install lens and bezel as outlined in Note 4c.

5. Align lamp assembly and tighten bolts in Steps 2 and 3.

6. Install rubber bumper over upper mounting stud.

7. Install rear bumper as outlined in Section 14, Note 5b.

8. Connect negative battery cable and check operation.

9. Rear Side Marker and Reflex Lamp Assembly (Except 693)

a. Removal

1. Open trunk compartment lid.

2. Remove trunk panel trim from side of car lamp is to be removed.

3. Remove two nuts securing housing to quarter panel side molding and remove housing assembly.

b. Installation

1. Install housing assembly on molding studs extending through quarter panel.

2. Secure housing assembly with two nuts.
3. Install trunk panel trim.
4. Close trunk compartment lid.

10. Rear Back-Up Lamp (Right or Left) (Except 693)

a. Removal

1. Remove two screws securing bumper filler to bumper and remove filler.
2. Disconnect wiring at connectors.
3. Remove two screws securing lamp to bumper filler and remove lamp.

b. Installation

1. Position lamp to bumper filler and secure with two screws.
2. Connect wiring connectors.
3. Position bumper filler to bumper and secure with two screws.

11. License Lamp Assembly

a. Removal

1. Disconnect license lamp wire connector.
2. Remove two screws securing license lamp assembly to center bumper bar and remove lamp.

b. Installation

1. Position lamp assembly to center bumper bar and secure with two screws.
2. Connect wire connector and check operation of lamp.

12. Trunk Lamp Assembly

a. Removal

1. Disconnect negative battery cable.
2. Open trunk lid.
3. Remove clip and disconnect trunk lamp lead wire at connector.
4. Remove one screw securing trunk lamp to lid and remove lamp.

b. Installation

1. Position trunk lamp to lid and secure with one screw.
2. Connect black lead wire at connector and secure with clip.
3. Connect negative battery cable.
4. Close trunk lid.

ELDORADO SERVICE INFORMATION

(NOTE: The service information that follows pertains only to the Eldorado. For Service procedures not given here, the procedure is the same as given for other 1972 Cadillac cars.)

13. Bulb Replacement—693

A complete list of replacement bulbs for 1972 Cadillac cars is given in the bulb chart, page 12-19. The procedures for making replacements described in this note are exclusive to Eldorados.

a. Front Turn Signal and Parking Lamp

1. Remove two captive screws at bottom of lamp assembly securing fender extension by inserting Phillips screwdriver below lip of bumper filler.
2. Remove two screws at top of lens securing fender extension and remove extension.
3. Remove two screws securing bezel and lens and remove lens.
4. Replace bulb.
5. Install lens and bezel and secure with two screws.
6. Install fender extension and secure with four screws.

b. Cornering or Front Side Marker Lamp

1. Remove cornering and front side marker light assembly as described in Note 16a.
2. Remove four screws securing bezel and lens to housing and remove lens.
3. Remove bulb.

(NOTE: Cornering light bulb is clear, while side marker light bulb is amber colored.)

4. Install bulb.
5. With gasket in proper location, position lens and bezel to housing and install four Phillips head screws retaining lens to housing.
6. Install cornering and front side marker light assembly as described in Note 16b.

c. Rear Tail, Stop, Signal and Side Marker Lamp

1. Remove two screw and nut assemblies from rear of lamp bezel.
2. Remove two screws from upper lamp bezel, one on each side.
3. Remove bezels.
4. Remove four screws securing lens and remove lens.
5. Install new bulb.
6. Install lens and secure with four screws.
7. Install bezels and secure with two screws and two screw and nut assemblies.

d. Back-Up Lamp

1. Remove two screws securing bezel and remove bezel.
2. Remove two screws securing lens and remove lens.
3. Install new bulb.
4. Install lens and secure with two screws.
5. Install bezel and secure with two screws.

14. Headlamp Housing Assembly (693 Only)

a. Removal

1. Disconnect head light wiring connectors.
2. Remove grille molding as described in Section 13, Note 3a.
3. Remove three screws and shims, one at top of assembly and two at bottom of assembly, securing housing to radiator cradle.
4. Remove headlamp assembly.

b. Installation

1. Position housing assembly in radiator cradle and loosely install three screws and required number of shims.
2. Install grille molding as described in Section 13, Note 3b.
3. Align housing and tighten screws.
4. Connect wiring connectors.
5. Reset headlight aim as outlined in Notes 1 or 2.

15. Front Turn Signal and Parking Lamp Assembly—693

a. Removal

1. Disconnect negative battery cable.
2. Disconnect electrical connector at radiator cradle tie bar and monitor if so equipped.
3. Working inside of fender, remove three nuts and washer assemblies securing lamp assembly to fender and remove assembly.

b. Installation

1. Position lamp assembly to fender and secure with three nuts and washer assemblies.
2. Connect electrical connector to mating connector at tie bar and monitor if so equipped.
3. Connect negative battery cable.

16. Front Cornering and Side Marker Lamp Assembly—693

a. Removal

1. Disconnect negative battery cable.

(NOTE: If working on right side of car, battery must be removed as described in Section 6, Note 19.)

2. Disconnect electrical connector to cornering lamp assembly at radiator cradle tie bar.
3. Remove three screws securing lamp assembly to fender and remove assembly from fender.

b. Installation

1. Position cornering and side marker light assembly to fender and install three screws securing assembly to fender.
2. Connect electrical connector to mating connector at tie bar.
3. Connect negative battery cable.

17. Rear Tail, Stop, Signal and Side Marker Lamp

a. Removal

1. Remove rear bumper assembly as described in Section 14, Note 15a.
2. Disconnect electrical connectors.
3. Remove two screws and remove lamp assembly.

b. Installation

1. Install lamp assembly into bumper outer end and secure with two screws.
2. Install electrical connectors.
3. Install rear bumper as described in Section 14, Note 15b.

18. Back-Up Lamp Assembly

a. Removal

1. Remove two screws securing bezel and remove bezel.
2. Remove fuel filler door as described in Section 14, Note 9a.
3. Loosen two screws securing lamp to bumper center bar and pull lamp assembly out.
4. Disconnect lamp wire and remove assembly.

b. Installation

1. Connect lamp wire and position lamp in bumper, loosely install two screws.
2. Install bezel and secure with two screws.
3. Align lamp assembly and tighten all screws.
4. Install fuel filler door as described in Section 14, Note 9b.

19. Rear Reflex Lens and Bezel Assembly

a. Removal

1. Remove two nuts and washers and remove reflex assembly.

b. Installation

1. Install reflex assembly and secure with two nuts and washers.

BULB DATA CHART

FUNCTION	BULB NO.	C/P	BODY STYLE
Accessory Switch Illumination	1445	.7	All (When Ordered)
Ash Tray Lamp	1445	.7	All
Back-Up Lamp	1156	32	All
Clock	1816	3	All
Cornering Lamp	1295	50	All
Courtesy Lamp-Sail Panel	90	6	68247-49-68347-49-69347
Courtesy Lamp-Instrument Panel	89	6	All
Courtesy Lamp-Rear Door	212/212-1	6	69723-69733
Courtesy Lamp-Rear Quarter Armrest	212/212-1	6	68367
Cruise Control Speed Selector Illum. Auto. Lock Lamps	1445	.7	All (When Ordered)
"Stop Engine Temp" Warning Light	168	3	All
Generator Telltale Lamp	161	1	All
Glove Compartment Lamp	1816	3	All
Headlamp-Inner	L4001	37.5 Watts	All
Headlamp-Outer	L4002	37.5W/50.0W	All
Headlamp Switch Lamp	1895	2	All
Heater Control or Climate Control Lamp	1895	2	All
High Beam Indicator	161	1	All
License Lamp	67	4	All
Low Brake Telltale Lamp	168	3	All
Low Oil Pressure Telltale Lamp	168	3	All
Low Washer Fluid Telltale	161	1	All (When Ordered)
Map Lamp	550	6	All
Marker Lamp-Front Side	97A	4	All
Marker Lamp-Rear Side	168	3	All Except 69347
Opera Lamp	756	.3	68169-69733 (When Ordered)
Panel Lamp	194	2	All
Park-Signal Lamp	1157 NA	32/3	All
Radio Dial Lamp	1895	2	All (When Ordered)
*Radio AM-FM Band Indicators	Special	–	All (When Ordered)
*Radio AM-FM Stereo Indicators	Special	–	All (When Ordered) Except 69890
*Radio AM-FM Stereo Tape Internal	Special	–	All (When Ordered) Except 69890
*Radio-Rear Control Indicator	250	1	69723-33 (When Ordered)
Rear Window Defogger Indicator Lamp	1445	.7	All (When Ordered) Except 697-698
Spot Lamp-Front Compartment	90	6	69733
Spot Lamp-Reading	1004	15	68169-69723-69733
Stop, Tail and Signal	1157	32/3	All
Trunk Compartment Lamp	1003	15	All Except 69890
Trunk Lid Telltale	161	1	All Except 69890 (When Ordered)
Turn Signal Indicator	194	2	All
Warning Lamp-Front Door (Combined with Courtesy Light)	212/212-1	6	68347-49-68169-69367-69347-69723-33
Warning Lamp-Rear Door (Combined with Courtesy Light)	212/212-1	6	68169-68349
Water Temperature Telltale	161	1	All Except 69890

*Serviceable only by Radio Technician.

FUSES

Unit	Fuse Rating
Body Feed	25 AMP.
Cigar Lighters	
Clock	
Courtesy Lights	
Glove Box Light	
Map Light	
*Reading Light, Chauffeur	
Trunk Light	
Seat Back Lock Relay	
Cornering and Parking Lights	10 AMP
Ash Tray Light	
Cornering Lights	
Front Side Marker Lights	
Parking Lights	
Directional Signal	25 AMP.
Back-Up Lights	25 AMP.
Rear Window De-Fogger	
Gages and Transmission Controls	10 AMP.
Brake Warning Light	
CCS Vacuum Solenoid	
Downshift Solenoid	
Fuel Gage	
Generator Light	
Low Oil Pressure Indicator	
Water Temperature Warning Light	
Headlights (Integral with headlight switch)	15 AMP. (CB)
Heater and Accessories	15 AMP.
Air Conditioning Amplifier	
Air Conditioning Blower Relay	
Cruise Control	
Heater Blower	
Power Windows	(CB)
Horns	(CB)
Convertible Top	
Door Locks	
Engine Metal Temperature Light	
Horns	
Power Seat	
Seat Back Lock Solenoid	
Instrument Panel Lights	4 AMP.
Radio	7 1/2 AMP.
Stop Lights and Hazard Warning Flasher	25 AMP.
Tail Lights	25 AMP.
License Light	
Rear Side Marker Lights	
Tail Lights	
Twilight Sentinel (Integral with headlight switch)	15 AMP. (CB)
Windshield Wipers	25 AMP.

Do not use fuses of higher amperage ratings than those recommended above.

AMP. - Ampere (CB) - Circuit Breaker

*Fleetwood Seventy-Five Limousine Only

THEORY OF OPERATION

(NOTE: Service information pertaining to the windshield wiper and washer system not found in this section is covered in the body service manual.)

A three speed, depressed park wiper and washer system is used on all 1972 Cadillac cars. The wiper system is a tandem, left hand articulated system. The wiper blades move in the same direction at the same time and park to the right. The articulation of the left side is provided by a parallel drag link pinned at the wiper transmission with a swivel mounting at the blade to arm connection. The combination of these features results in increased wiper coverage for maximum forward visibility.

The windshield wiper and washer assembly is mounted on the cowl. The wiper unit drives a separate link connected directly to each wiper transmission. When in the park (off) position, the wiper arms and blades are concealed under the rear of the hood.

The wiper and washer assembly consists of a wiper unit, which contains a 12-volt motor, a gear box section, a relay control and a washer unit.

The wiper and washer assembly is controlled by a four-way switch and push button located on the instrument panel extension, which is actually a part of the driver's door, Fig. 12-13. The wipers can be operated at three different speeds plus a mist operation. The washers are activated by depressing the washer button, integral with the switch. When the washer button is pushed, the switch lever is moved mechanically to the low speed position until the operator moves it to the "OFF" position.

Wiper Electrical Operation

LOW SPEED – Moving the control switch lever to the "Lo" speed position, Fig. 12-14, connects the relay control and shunt field circuit directly to ground. This provides the following circuit:

Current feed to the 25 amp windshield wiper fuse in the fuse panel comes from the accessory terminal on the ignition switch. Current flows through the yellow wire to terminal number 2 of the wiper motor. It then flows through the tan wire to one contact point on the relay switch, and on through the relay coil and through the red wire back to terminal No. 1, through the light blue wire and the switch to ground. After passing through the relay points, current flows through the black with double pink tracer wire through the series field and divides; part flowing through the armature and circuit breaker and through the black ground wire, the other part flowing through the shunt field, the solid black wire to terminal number three, and on through the black with double orange tracer wire to ground at the control switch. Current by-passes the 20 ohm resistor ground circuit at terminal No. 3 at this time, because of the lower resistance of the control switch ground circuit.

MEDIUM SPEED – Moving the control switch to the "Medium" speed position, Fig. 12-14, connects a 13 ohm resistor, located in the control switch, in parallel with the 20 ohm resistor connected from the shunt field circuit. These two resistors, connected in parallel, provide slightly less than 8 ohms resistance in the shunt field, allowing less current to flow in the shunt field. This permits correspondingly more current in the armature circuit, resulting in medium speed.

HIGH SPEED – Moving the control switch lever to the "High" speed position, Fig. 12-14, eliminates the path to ground in the control switch, leaving only the 20 ohm resistor in the shunt circuit. This one resistor allows even less current to flow through the shunt field than was possible at either medium or low speeds, which results in high speed operation.

MIST – Moving the control lever down to the "Mist" position, Fig. 12-14, and holding there until the wipers move out of the park position before releasing, will allow the wipers to make one complete low speed cycle wipe of the windshield and return to the park position.

Washer Circuit

Depressing the washer button on the control switch, mechanically moves the wiper switch lever to the "Lo" speed position. The washer relay coil is energized by the current flowing from the No. 2 terminal on the wiper unit connector through the yellow wire into the relay coil and from there through the dark blue with white striped wire to ground.



Fig. 12-13 Wiper and Washer Control Switch

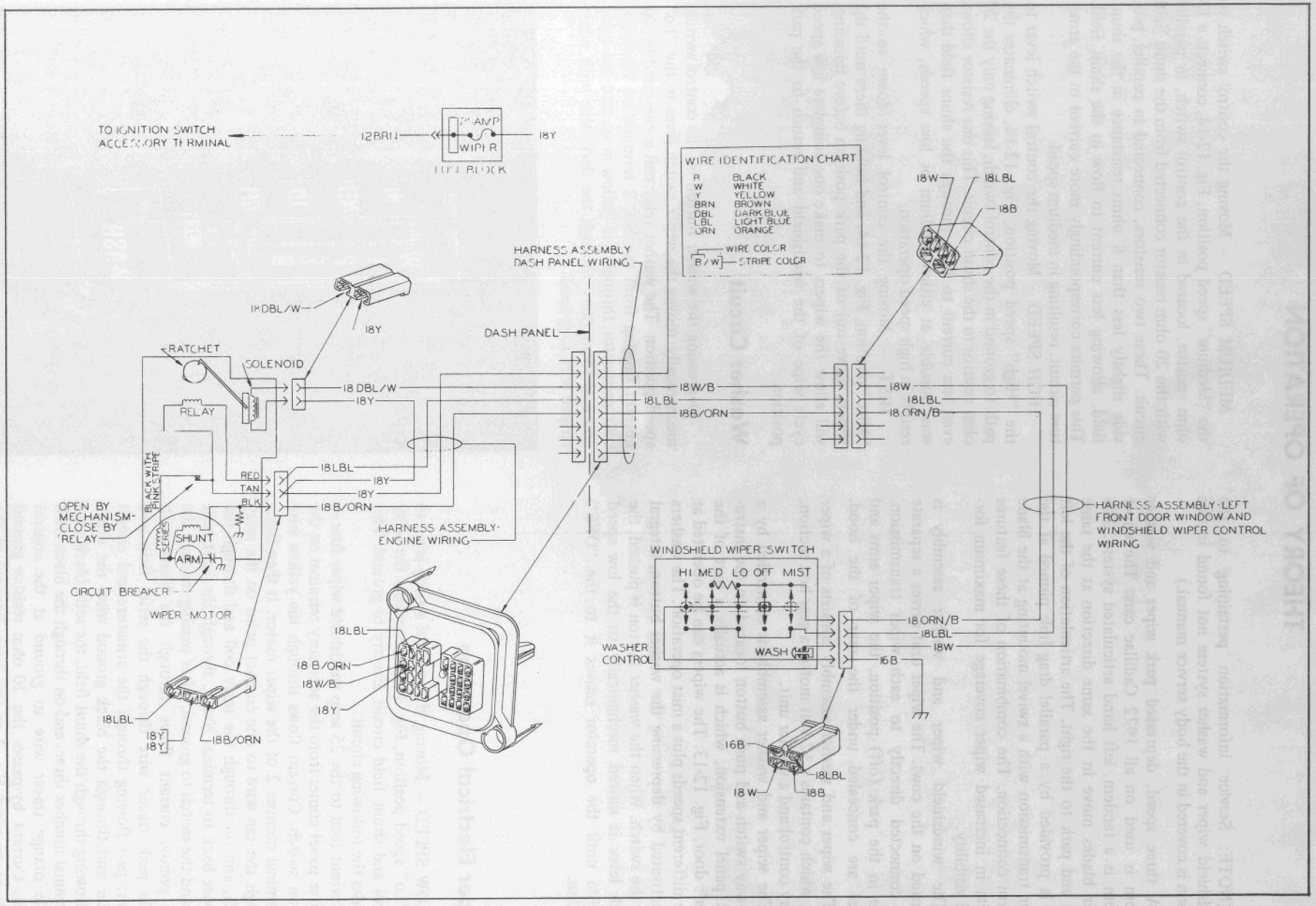


Fig. 12-14 Wiper and Washer Electrical Circuit

(NOTE: For information pertaining to the windshield washer low fluid level indicator, refer to page 15-37.)

20. Windshield Wiper and Washer Switch

a. Removal

1. Disconnect negative battery cable.
2. Open left front door to gain access to screw securing control switch to instrument panel extension on door.
3. Loosen screw securing control switch to extension.
4. Pull control switch out and disconnect electrical connector.

b. Installation

1. Connect electrical connector and place control switch into instrument panel extension on left front door.
2. From front of door, tighten screw securing control switch to extension.
3. Install negative battery cable.

PANEL INSTRUMENTATION
THEORY OF OPERATION

Warning Lights

The air-core type fuel gage is mounted in a housing at the left side of the speedometer face in the instrument panel cluster. The gage uses balanced needle construction, which means that when the ignition is turned "OFF", the pointer may come to rest at any point.

The instrument cluster has nine indicator lights, Fig. 12-21; five on the extreme right end within the large bright beaded area and two on both the left and right ends of the speedometer dial face. From top to bottom, the five lights located on the right of the speedometer are as follows: Left row; stop eng.—oil, blank and engine temp, right row; brakes, generator and water temperature. The windshield washer low fluid level light is located below the left turn signal indicator. The trunk light is located below the right turn signal indicator.

The red brake warning light will light whenever brake pedal travel exceeds a predetermined amount. The red engine temperature light will light whenever the cylinder head metal temperature exceeds 295°F. With the ignition on, the amber trunk light will come on whenever the trunk lid is unlocked on cars equipped with a remote control trunk lid. The red oil or generator lights will come on whenever oil pressure is low or the generator is not charging. The red water temperature light will light when the coolant temperature exceeds 264°F. The amber windshield washer low fluid level light will come on when the fluid level in the windshield washer bottle has approximately one third capacity remaining.

The blue, headlamp high beam indicator is located just below the sixty mile per hour mark on the speedometer dial face and will light when the high beam lights are on.

Speedometer and Odometer

The speedometer and odometer are driven by a gear train in the speedometer housing, which is driven through a flexible shaft that is connected to the transmission. The flexible shaft is driven at the transmission by an output gear designed especially for the vehicle which takes into consideration variables such as tire size and differential ratio.

The odometer portion, which indicates distance traveled, is divided into two sections - the left half (season odometer) records accumulated mileage and the right half indicates trip mileage. A reset knob for the trip odometer is located in the instrument cluster. Push in fully and turn clockwise to reset. No attempt should be made to reset the season odometer. An anti-reverse pawl prevents driving the odometer in a reverse direction and tear-out spacers will provide a visible indication if the odometer wheels are rotated forceably.

Turn Signals

The turn signal indicators are located in the speedometer dial face and light up as green arrows when the turn signals or hazard warning flasher are used.

Horns

Twin "F" and "A' seashell horns, matched in tone, are mounted on a single horn mounting bracket in the box section directly behind the left headlamp on all models. In addition to these horns, all DeVille models have a low "D" horn mounted to this same horn mounting bracket. A high "C" trumpet horn is available as optional equipment on all models. The horn relay is mounted inside the car on the dash insulator to the upper left of the brake pedal.

Clock

The clock is located on the instrument panel above the glove box door. It has a spring drive movement which is electrically wound.

The clock rewinds approximately every forty seconds and draws current for only the fraction it takes to wind. It can be reset by pushing in and turning the reset knob. Automatic regulation occurs when the knob is moved.

Engine Metal Temperature Switch

The engine metal temperature switch, located on the rear of the left cylinder head, senses the metal temperature of the engine. When engine temperature exceeds 295°F, the switch closes, completing the circuit to ground, causing the "Stop Eng.-Temp." tell-tale to light and the buzzer to sound. The tell-tale also will light and buzzer sound when the driver's door is opened with the key in the ignition lock and the ignition off.

The electrical instruments portion of this section covers disassembly, assembly and testing procedures of serviceable instrument panel components. Procedures for removal and installation of electrical instruments that may be considered a part of, or attached to, the instrument panel are in the instrument panel portion of this section.

Engine Metal Temperature System Circuitry (Fig. 12-15)

When engine metal temperature exceeds 295°F, the engine temperature switch closes. Current from the horn circuit breaker flows through the 14 orange with black stripe wire, through the relay coil, through the normally closed (N.C.) contact points, through the 18 white wire to the bulkhead connector. The current then flows

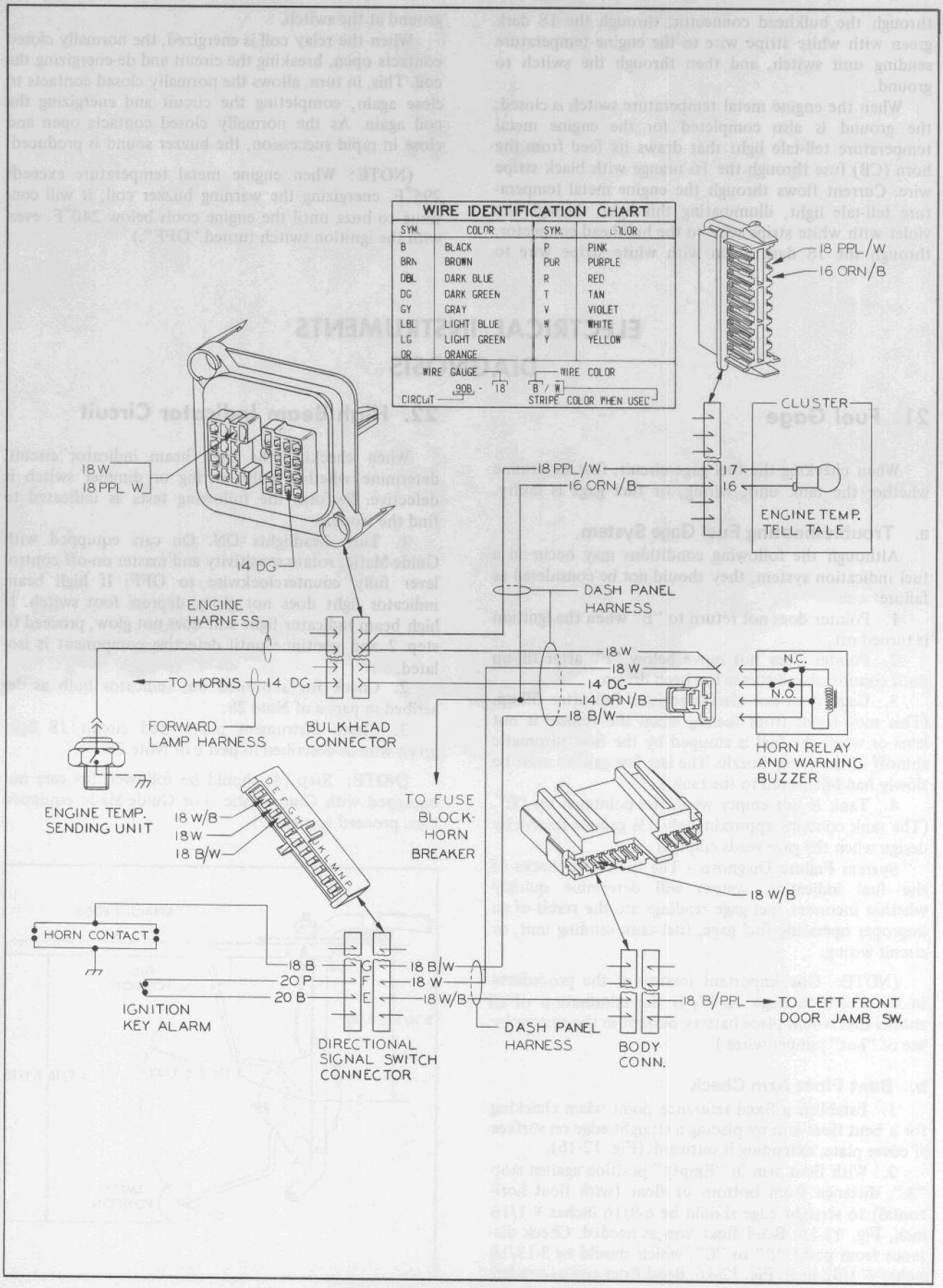


Fig. 12-15 Engine Temperature Warning System

through the bulkhead connector, through the 18 dark green with white stripe wire to the engine temperature sending unit switch, and then through the switch to ground.

When the engine metal temperature switch is closed, the ground is also completed for the engine metal temperature tell-tale light that draws its feed from the horn (CB) fuse through the 16 orange with black stripe wire. Current flows through the engine metal temperature tell-tale light, illuminating this light, through the violet with white stripe wire to the bulkhead connector, through the 18 dark green with white stripe wire to ground at the switch.

When the relay coil is energized, the normally closed contacts open, breaking the circuit and de-energizing the coil. This, in turn, allows the normally closed contacts to close again, completing the circuit and energizing the coil again. As the normally closed contacts open and close in rapid succession, the buzzer sound is produced.

(NOTE: When engine metal temperature exceeds 295°F. energizing the warning buzzer coil, it will continue to buzz until the engine cools below 240°F. even with the ignition switch turned "OFF".)

ELECTRICAL INSTRUMENTS DIAGNOSIS

21. Fuel Gage

When checking the fuel gage circuit, first determine whether the tank unit, wiring, or fuel gage is faulty.

a. Troubleshooting Fuel Gage System

Although the following conditions may occur in a fuel indication system, they should not be considered as failure:

1. Pointer does not return to "E" when the ignition is turned off.
2. Pointer does not move below "F" after fill-up until considerable distance has been driven.
3. Gage does not always register full after fill-up. (This may result from fueling when the vehicle is not level or when the fuel is stopped by the first automatic shutoff of the pump nozzle. The last few gallons must be slowly hand-delivered to the tank.)
4. Tank is not empty when the pointer is on "E". (The tank contains approximately 1½ gallons reserve by design when the gage reads empty.)

System Failure Diagnosis - The following checks of the fuel indication system will determine quickly whether incorrect fuel gage readings are the result of an improper operating fuel gage, fuel tank sending unit, or circuit wiring.

(NOTE: One important feature of the procedures in the chart on page 12-27, is the elimination of all checks that would place battery current in the system by use of "hot" jumper wires.)

b. Bent Float Arm Check

1. Establish a fixed reference point when checking for a bent float arm by placing a straight edge on surface of cover plate, extending it outward. (Fig. 12-16).
2. With float arm in "Empty" position against stop "A", distance from bottom of float (with float horizontal) to straight edge should be 6-9/16 inches ∓ 1/16 inch, Fig. 12-16. Bend float arm as needed. Check distance from point "B" to "C", which should be 3-13/16 inches ∓ 1/32 inch, Fig. 12-16. Bend float arm as needed and recheck distance from bottom of float to straight edge.

22. High Beam Indicator Circuit

When checking the high beam indicator circuit, determine whether bulb, wiring or dimmer switch is defective. Perform the following tests as indicated to find the trouble.

1. Turn headlights ON. On cars equipped with Guide-Matic, rotate sensitivity and master on-off control lever fully counterclockwise to OFF. If high beam indicator light does not glow, depress foot switch. If high beam indicator light still does not glow, proceed to step 2 and continue until defective component is isolated.
2. Check for a burned out indicator bulb as described in part a of Note 28.
3. Check instrument panel feed circuit 18 light green wire as described in part c of Note 28.

(NOTE: Step (4) should be followed for cars not equipped with Guide-Matic. For Guide-Matic equipped cars, proceed to step 5.)

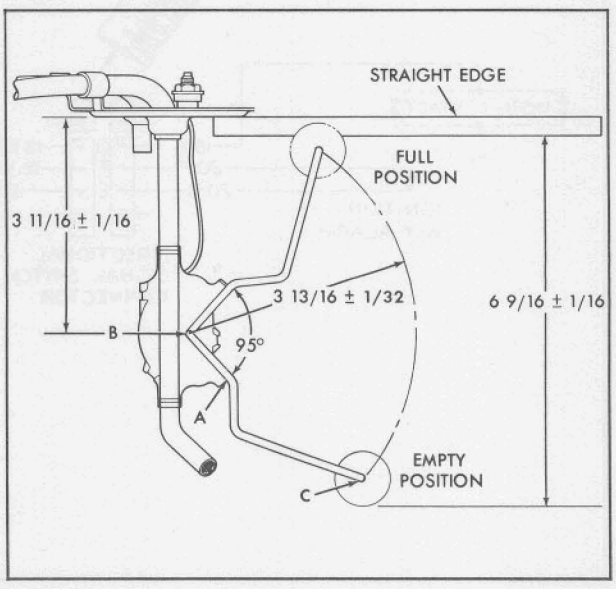


Fig. 12-16 Checking for Bent Float Arm

(NOTE: Never apply 12-volt current directly to the fuel tank float unit body feed wire as this will destroy the unit's resistor.)

Erratic Fuel Gage Readings

Inspect all circuit wiring for damage to insulation and wire, also carefully check to assure good electrical connections are provided at the following locations:

1. Terminal connections at tail panel connector.
2. Ground connection from tank unit to rear frame rail.
3. Body harness connector in left rear quarter trunk area.
4. Body harness connector to chassis harness under instrument panel.
5. Chassis harness connector to cluster printed circuit.
6. Mounting screws at the fuel gage dash unit connecting terminal conductors to printed circuit.
7. Make sure gage pointer is free to operate and not contacting the back side of the speedometer dial.

Gage Always Registers Full
(With ignition switch on)

Most probable cause is an open circuit in wiring or tank unit.

1. Check ground wire from tank to rear frame rail for positive attachment. If loose, clean wire terminal, reinstall and check indication. Install new terminal, if broken.
2. Connect a spare tank unit (with a feed and ground wire attached) to the tan wire terminal in the body harness connector and provide ground. Raise and lower the float arm slowly, observing the dash unit.

a. If dash unit does not function, an open circuit between dash and tank unit is indicated. Locate cause of open circuit in wiring and repair. (If fuel gage, oil pressure light and generator tell-tale fail to register, the fault may be an open in the 18 pink wire to the printed circuit.)

b. If the dash unit follows the arm movement, proceed to step 3.

3. Inspect the wire terminals at the tank unit, after lowering the fuel tank.

If connection is loose, clean terminal and reinstall wire. If gage continues to register full (with tank empty), remove the tank unit. Reconnect the wiring with unit out of tank, including the ground, and move float arm. If dash unit does not follow arm movement, replace the float unit.

Gage Always Registers Empty
(With ignition switch on)

Most probable cause is a grounded circuit in the wiring due to a pinched or cut wire, or shorted fuel gage dash unit.

Disconnect the tank unit feed wire at the tail panel connector, behind the license plate. The dash unit gage should now register full.

Gage Continues to Register Empty

1. Remove upper instrument panel cover.
2. Remove plastic cover from top of fuel gage cluster unit. Remove rear printed circuit to conductor screw (screw closest to bezel) and separate printed circuit from terminal. Turn ignition switch "ON". Gage should read full.

a. If gage now reads full, the wiring harness is shorted to ground between the tank unit and the dash gage. Reconnect the dash gage printed circuit by installing screw and correct the grounded wiring condition.

b. If fuel gage dash unit continues to register empty, replace the dash unit.

Gage Now Registers Full

1. Connect a spare tank float unit to the tank feed wire (tan) at the body harness connector in the body tail panel and ground the unit by using a jumper between the mounting flange of the float unit and the trunk latch mechanism (trunk open).
2. Raise and lower the float arm slowly while observing the dash gage.

a. If dash unit still does not operate, replace dash unit.

b. If the dash gage follows the float arm movement, lower the fuel tank and check float unit field wire for insulation breakdown or damage. If wire is normal, remove tank float unit.

3. Check float unit for improper installation of fuel filter which could restrict movement of the float arm. Reposition filter if necessary and reconnect wiring at the tail panel connector and on the float unit out of the tank and check for dash gage operation by moving the float arm.
4. If dash unit operates, check inside of tank for mislocated or deformed baffle.

If dash gage still does not follow the float unit arm movement, replace the float unit.

4. If step 3 does not check satisfactorily, remove foot switch connector and touch one lead of a test lamp that is not self powered to 16 light blue wire and ground other lead. Lamp should light. If it does not light, proceed to step 5. If it does light, dimmer switch or 18 light green wire to printed circuit is defective. Replace dimmer switch on a trial basis. If the problem is not in dimmer switch, the 16 light green wire is open.

5. If step 3 does not check satisfactorily, disconnect 3-way connector (yellow, light blue and violet wires) at Guide-Matic power relay. High beam indicator should glow. If it does not, replace power relay.

If light glows with connector disconnected but does not glow with connector connected, disconnect 3-way connector at foot switch. If light glows, replace foot switch.

If the above procedures fail to cause high beam indicator to glow, check four-way connector at guide-matic amplifier. If connector is good, replace amplifier.

6. Using a test lamp that is not self powered, probe 16 light blue wire at headlight switch, and ground other lead. Lamp should light. If it does, open is in 16 light blue wire between headlight switch and dimmer switch.

7. Probe 14 red wire at headlight switch with one test lamp lead of a test lamp (not self powered) and ground other lead. Lamp should light. If it does light, headlight switch should be replaced. If lamp does not light, trouble is in wiring from headlight switch to positive battery terminal. Begin at No. 1 terminal connection of headlight switch and check continuity of circuit.

23. Trunk Lid Circuit

When checking trunk lid circuit determine whether trunk lid switch, bulb, wiring or printed circuit is defective. Perform the following test to isolate the condition.

a. Trunk Lid Open

1. With trunk lid open and ignition switch in the "RUN" position, trunk tell-tale bulb in instrument panel should glow. If it does not, proceed to step 2 and continue until defective component is isolated.

2. Disconnect wire connector at trunk lid release mechanism and use a paper clip to ground the wire connector. If bulb lights, but did not light in step 1, the switch must be replaced.

3. Check for a burned out indicator bulb as described in part a of Note 28.

4. Check 18 pink wire to the printed circuit as described in part c of Note 28. An open in this wire will also cause the fuel gage and the generator tell-tale to be inoperative.

(NOTE: This wire also feeds water temperature indicator light and the low brake light.)

5. Check 18 dark green wire for an open as described in part d of Note 28.

6. Check printed circuit (Circuit No. 1 and No. 5) for an open as described in part f of Note 28.

b. Trunk Lid Closed

1. With lid closed, ignition in "RUN" position, trunk tell-tale should not glow. If it does, proceed to step 2.

2. Disconnect wire connector at trunk lid release mechanism and close lid. If lamp glows, check #18 dark green wire for a short as described in Note 28.

3. If lamp does not glow, check switch for short or inoperative plunger.

24. Combination Brake Valve

The combination brake valve is in line with the brake lines and cannot be adjusted. If defective, it must be replaced. If an inoperative low brake indicator circuit is suspected, the bulb and wiring may be checked as outlined in Note 28, parts a through f.

25. Oil Pressure Indicator Circuit

The oil pressure indicator light is connected in a circuit with the ignition switch and a pressure operated switch threaded into the oil header galley at rear of engine. Indicator light warns driver when oil pressure is below 4 pounds ∓ 1-1/2 pounds.

a. Ignition On – Engine Not Running

1. Turn ignition switch to "RUN" position but do not start engine. If oil indicator light glows, proceed to Section b of this Note. If it does not, proceed to step 2 and continue until defective component is isolated.

2. If oil pressure light, fuel gage, generator tell-tale and temperature tell-tale fail to register, fault is probably an open in 18 pink wire to printed circuit, part c of Note 28.

3. Disconnect #18 dark blue wire at oil pressure switch and use a paper clip to ground the wire connector. If oil light glows, oil pressure switch is open and should be replaced.

(NOTE: Sealing compound on threads of switch may cause this condition and should never be used.)

4. Check condition of 18 dark blue wire from printed circuit to oil pressure switch as described in part d of Note 28.

5. Check condition of tell-tale bulb as described in part a of Note 28.

6. Check for open conductor in printed circuit as described in part f of Note 28.

b. Engine Running

1. Start engine and after running for 30 seconds, the oil pressure indicator light should not glow. If it does, proceed to step 2 and continue until defective component is isolated.

2. Disconnect 18 dark blue wire at oil pressure switch. If "Oil" light remains on, check 18 dark blue wire for a short to ground as described in part e, Note 28. Repair or replace as necessary.

3. If light goes out when 18 dark blue wire is disconnected, the oil pressure switch is shorted or the oil pressure is low, replace switch on trial basis. If new switch does not correct condition, remove switch and test pressure with a reliable pressure gage. Repair as necessary.

26. Water Temperature Indicator Circuit

When checking the water temperature tell-tale circuit, determine whether engine thermoswitch unit, wiring, dash unit or printed circuit is faulty. Perform the following tests to isolate the trouble.

a. Ignition in "START"-Bulb Does Not Light

1. Turn ignition to "START" position. Tell-tale bulb should come on during cranking and go out when engine starts. If bulb fails to light, proceed to step 2 and continue until defective component is isolated.

2. Check for burned out tell-tale bulb as described in part a of Note 28.

3. Check for an open 18 dark green wire between the ignition switch and printed circuit, part c of Note 28.

4. Check ignition switch grounding circuit "ground No. 1" in crank as described in part b of Note 28.

5. Check for an open in the printed circuit (#18 circuit) as described in part f of Note 28.

b. Ignition On—Tell-Tale Registers Hot Under All Conditions

1. Turn ignition switch to "RUN" position. If tell-tale comes on under all conditions, proceed to step 2 and continue until defective component is isolated.

2. Disconnect 18 dark green wire from thermo switch wiring harness connector in area of the ignition coil. If light does not go out, proceed to step 3, if light turns off, proceed to part c of this note.

3. Check for shorted condition in 18 dark green wire as described in part e of Note 28. Locate short and repair.

4. Check for a shorted printed circuit (#18 circuit) as described in part f of Note 28.

c. Engine Thermoswitch Unit Check

1. Disconnect 18 dark green wire from thermo-switch unit at wiring harness connector in the area of the ignition coil.

2. Connect a self-powered test lamp consisting of a three-candle power bulb and a pair of test leads in circuit by clipping one lead to terminal of the wire from the thermoswitch unit and the other lead to ground. Test bulb should not light. If it does light when connected in this manner, and the engine is cold, thermoswitch unit is grounded and should be replaced.

3. Remove test lead from switch terminal and touch it to body of unit. Bulb will light if unit is grounded properly. If it does not light, check for presence of sealing compound around threads of unit. Remove compound and repeat test.

(NOTE: Never use any sealing compound on thermoswitch unit to stop water leaks. If tightening unit does not stop leakage, it should be replaced.)

4. Remove test lamp and install dash gage wire on thermoswitch unit jumper connector if it tests satis-factorily.

27. Engine Metal Temperature Indicator Circuit

1. Disconnect electric connector at engine temperature switch and ground 18 dark green with white striped wire. Engine temperature tell-tale light should light and key buzzer should sound.

2. If system fails completely to perform as outlined in step 1, proceed as follows:

a. Check for open circuit breaker by actuating horns. If horns fail to blow, check for defective breaker.

b. Check for open in 18 violet with white stripe wire to the bulkhead connector.

c. If buzzer did not sound, ground #4 at horn and buzzer relay to determine if failure is in relay or in 18 white wire.

d. If engine temperature tell-tale light failed to light, check for burned out bulb and check printed circuit as described in Note 28.

Hot Circuit	Wire Color Code	Preliminary Steps
High Beam Indicator	18 Light Green	Headlamp switch all the way out. Dimmer switch on Hi- Beam.
Illumination	18 Gray	Headlamp switch halfway or fully out.
Turn Indicator	(RH) 18 Dark Blue (LH) 18 Light Blue with Black stripe	Ignition switch on and signal lever actuated.
Ignition, which feeds all other instrument panel circuits other than those above.	18 Pink	Ignition switch on and signal lever actuated. Ignition switch is in on position.
"Eng. Temp."	18 Violet with White	None
Washer Fluid	Black	Ignition Switch on, jumper across washer bottle float terminals.

28. Checking Circuits Using Printed Circuit

If any of the following circuits do not operate properly, check the corresponding notes to isolate the problem: fuel gage circuit, Note 21; high beam indicator circuit, Note 22; trunk lid circuit, Note 23; oil pressure tell-tale circuit, Note 25; charging circuit; Section 6, temperature circuit, Note 26; "Eng. Temp." tell-tale, Note 27.

If performing checks on the illumination circuit, proceed directly to this note.

a. Checking for Burned Out Bulb

1. All bulbs on right hand side of cluster can be reached through access hole after removal of switch panel on right hand side of cluster. Left hand bulbs can be reached from below. Upper central and left hand illumination bulbs and high beam may require top cover removal.

2. Remove wedge base socket bulb for affected circuit, Fig. 12-17, and replace if necessary.

3. If bulb is all right, install and proceed to part b of this note.

b. Checking Instrument Panel Ground Circuits for Open

1. Remove instrument panel top cover as described in Note 40a.

2. Disconnect 18 way cluster connector.

3. To check circuit, touch one lead of self-powered test lamp to ground circuits 18 black wire (#8 and #14) and ground other lead. If test lamp does not light, trace wiring and repair open circuit. If lamp lights, proceed to part c.

c. Checking Instrument Panel Feed Circuits For Open

1. Remove upper instrument panel cover as described in Note 40a, if not done previously. Leave battery cable attached.

2. Disconnect 18-way connector at back of instrument panel cluster case.

3. Use the following table to identify the circuit wiring color code and perform preliminary steps needed to check the continuity.

4. To check any circuit touch one lead of a test lamp that is not self- powered to feed circuit terminal at wiring harness connector of affected circuit and ground other lead. Test lamp should light. If it does not light, trace the circuitry to the harness connector using chassis circuit diagram at back of this section. If test lamp lights, proceed to part d of this note.

d. Checking Sender Circuits or Switch Side of Circuit for Open

1. Remove upper instrument panel cover as described in Note 40a, if not done previously.

2. Disconnect 18-way connector at back of instrument panel cluster case, if not done previously.

3. Use the following table to identify the circuit wiring color code and perform the necessary preliminary steps needed to check the continuity of the circuit.

4. To check the circuit, touch one lead of a test lamp that is self-powered to terminal at wiring harness connector of affected circuit and ground other lead. Test lamp should light, if it does not light, trace circuitry wiring and affected sender or switch by using chassis circuit diagram at back of this section. If it does light, proceed to part e of this note.

INSTRUMENT CLUSTER PRINTED CIRCUIT LEGEND

No. and Circuit	Wiring Color Code
1 Stop Eng. Oil	18 Dark Blue
2 Water	18 Dark Green
3 Gen.	16 Brown
4 Brakes	18 Tan
5 Ignition - Feeds Fuel Gage, Low Brake Tell-Tale, Trunk Tell-Tale, Generator Tell-Tale, Oil Pressure Tell-Tale, and Water Temp Tell-Tale	18 Pink
6 Fuel Gage (Sender Side)	18 Tan
7 Illumination (Feed Side)	18 Gray
8 Ground	18 Black
9 Hi-Beam Indicator	18 Light Green
10 L.H. Signal Indicator	18 Light Blue with Black
11 Accessory Feed To Washer Fluid Tell-Tale	18 Light Blue
12 Washer Fluid (Switch Side)	18 Black with White
13 Trunk Lid (Switch Side)	18 Dark Green
14 Ground	18 Black
15 R.H. Signal Indicator (Switch Side)	18 Dark Blue
16 Battery Feed to Stop Eng. Temp. Tell-Tale	16 Orange with Black
17 Stop Eng. Temp.	18 Violet with White
18 Not Used	

Sender or Switch Circuit	Wire Color Code	Preliminary Steps
Fuel Gage (Sender Side)	18 Tan	
High Beam Indicator	18 Light Green	Disconnect and ground light green lead at dimmer switch connector.
Trunk Lid (Switch Side)	18 Dark Green	Deck lid open.
Low Brake (Switch Side)	18 Tan (cavity #4)	Disconnect 18 Tan wire at distributor and Switch Assembly Ground 18 Tan wire with jumper wire.
Oil Pressure Tell-Tale	18 Dark Blue	Ignition off.
"Water Temp." Tell-Tale	18 Dark Green (cavity #2)	Disconnect 18 dark green wire at thermoswitch wire harness connector in ignition coil area and ground engine harness connector.
"Eng. Temp." Tell-Tale	18 Violet with White	Disconnect 18 Light Green wire at cylinder head sending unit and ground wire.
Washer Fluid	18 Light Blue	Wiper switch in low position.

e. Checking Sender Circuits or Switch Side of Circuit for Short

1. Remove upper instrument panel cover as described in Note 40a, if not done previously.

2. Disconnect 18-way connector at back of instrument panel cluster case, if not done previously.

3. Use the following table to identify the wiring color code of the circuit and perform the necessary preliminary steps needed to check the circuit for shorts.

4. To check the circuit, touch one lead of a test lamp that is self-powered to terminal at wiring harness connector of affected circuit and ground other lead. Test lamp should not light. If it does light, trace the wiring from the affected sender or switch and repair short in wiring by using chassis circuit diagram at back of this section.

f. Checking Printed Circuit

If faulty circuit cannot be found using the procedures previously described, check the affected printed circuit as outlined below.

1. Remove upper instrument panel cover as described in Note 40a, if not previously removed.

2. If bulbs are all right, use a self-powered test lamp to check the continuity of these circuits. Check both the feed or hot circuit and the ground and the switch or sender feeds of the affected circuit. If defective, remove instrument panel cluster as described in Note 42a and the printed circuit must be replaced as described in Note 49a.

Sender or Switch Circuit	Wire Color Code	Preliminary Steps
Fuel Gage (Sender Side)	18 Tan	Disconnect wire at connector inside license plate mounting door. On 693 styles, disconnect tan feed wire connector inside trunk.
Trunk Lid (Switch Side)	18 Dark Green	Disconnect wire at deck lid.
Low Brake (Switch Side)	18 Tan (cavity #4)	Disconnect 18 Tan wire at Distributor and Switch Assembly.
Oil Pressure Tell-Tale (Sender Side)	18 Dark Blue	Disconnect 18 Dark Blue wire at oil pressure switch.
"Water Temp." Tell-Tale. (Sender Side)	18 Dark Green (cavity #2)	Disconnect 18 Dark Green connector at thermoswitch unit.
"Eng. Temp." Tell-Tale	18 Violet with White	Disconnect 18 Light Green wire at cylinder head unit.
Washer Fluid	18 Light Blue	Wiper switch in "off" position.

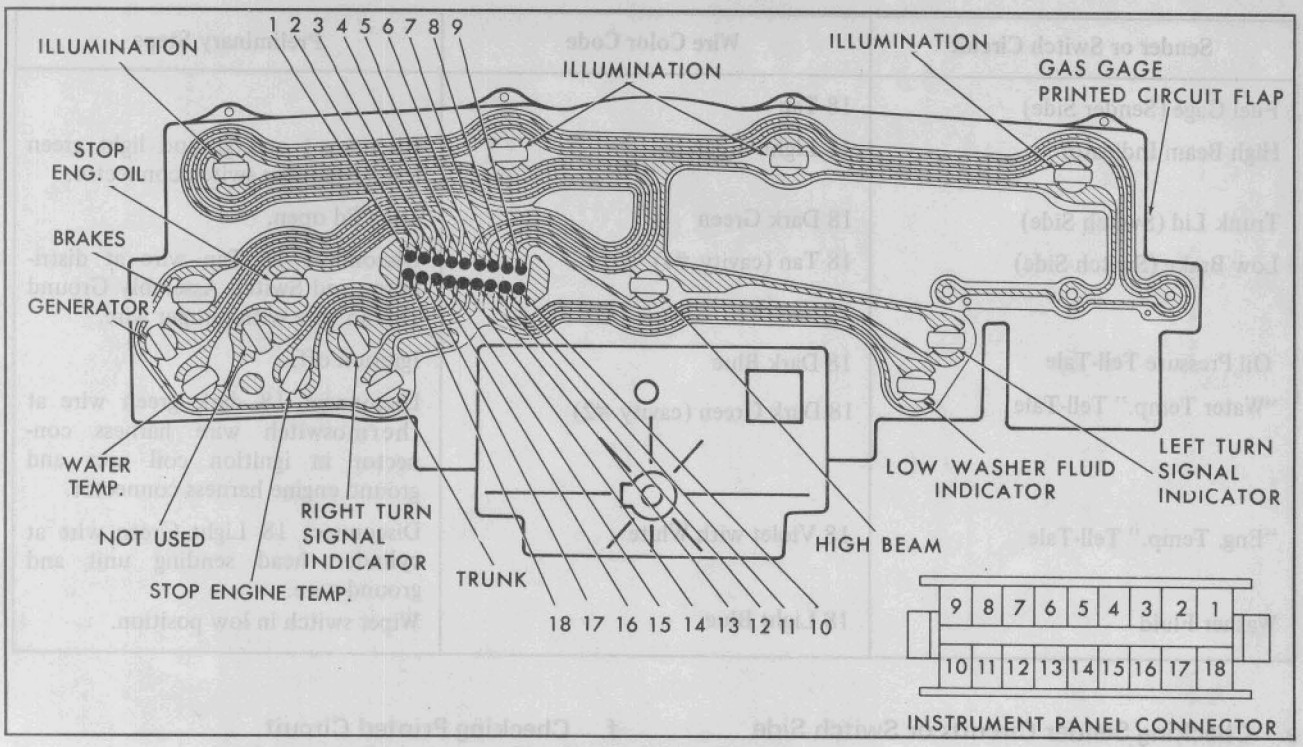


Fig. 12-17 Printed Circuit

29. Directional Signal Switch Service

The switch that operates the front fender cornering light is integral with the directional signal switch. It is part of the switch block included in the switch assembly, and is serviced with the switch.

Automatic canceling of the turn signal lights and cornering lights when lit is achieved by means of a cam connected to the steering wheel hub and a ratchet that is integral with the switch assembly. When the steering wheel is turned in the direction for which the control is set, the cam passes the ratchet without engaging, but when the wheel is turned in the opposite direction, the cam engages the ratchet and cancels the signal and cornering light.

The signal flasher, which is identical for both columns, is a sealed non-adjustable unit located on the lower steering column cover. If inoperative, it must be replaced. The flasher makes an audible signal when the circuit is energized. This serves as an additional warning that the signal is operating.

When the signal system is operating properly, the lights flash about 75 to 105 times per minute at 12.8 volts. If either a front or rear turn signal bulb burns out, the reduced current in the circuit will cause the remaining signals on that side of the car to burn steadily.

30. Horn Operation and Testing

Conditions that may affect horn performance and procedures for checking these conditions are listed below:

1. Actuate horn by depressing the steering wheel pad in any area. Horn should blow. If horn fails to blow, proceed to step 2.

2. While horn is energized, tap horn lightly. If horn blows, proceed to step 3. If horn fails to blow, refer to step 6 of this procedure.

3. Release cushion so that horn will stop blowing.

4. Energize horn again. If horn blows normally, a particle of foreign material between the contact points caused the trouble and no adjustment is necessary.

5. If horn still fails to blow when tapped, turn adjustment screw, Fig. 12-18, one full turn counterclockwise with pliers.

(NOTE: This adjustment is sensitive. Do not turn screw more than one full turn or in wrong direction (clockwise). Misadjustment will require removing horn for adjustment on bench as described in Section d of this note.)

6. Check horn for normal operation. If still inoperative, inspect circuit breaker to assure power is available, then perform the following checks.

a. Connect a jumper lead to number "3" and number "1" terminals of horn relay. If horn blows, trouble is in relay, steering wheel pad switching or wiring. Remove jumper lead.

b. To determine whether steering wheel pad switches or wiring is at fault, ground number "2" terminal of relay. If horn blows, pad switching or wiring is at fault.

c. Use a jumper from an area cleared of paint on horn bracket to grounded metal on radiator cradle, check for no ground due to corrosion or paint on bolt threads. If horn blows, clean bolt threads and horn bracket surfaces which mate with radiator cradle.

d. If horn does not blow and wiring between battery and relay is not defective, connect a voltmeter between terminal on the horn and a paint free area on

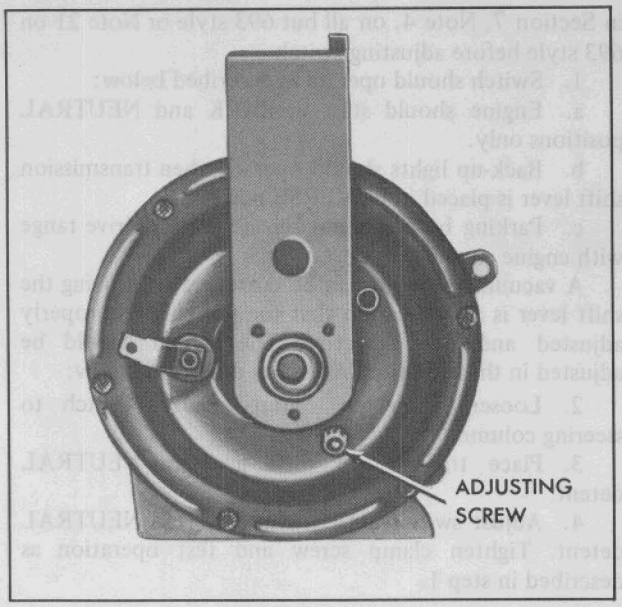


Fig. 12-18 Horn Adjusting Screw

the radiator cradle. Connect a jumper lead to number "3" and number "1" terminals of relay and note voltmeter reading.

e. If no voltmeter reading is obtained, wiring between relay and horn is open.

f. If voltmeter reading is less than 7.0 volts, trouble is due to high resistance connections in battery connection or wiring.

g. If voltmeter reading is above 7.0 volts, trouble is due to a faulty horn. In this case, test horn for current draw.

7. If no trouble is located during these checks and horn is still inoperative, remove horn for a bench check.

b. Horn Tone Poor

1. Harsh tone - caused by loose bolts in sheet metal mounting area.

2. Low pitch roar - sounds like "moo-ing" and is caused by too high a current. Horn needs adjusting.

3. Weak tone - caused by too low a current. Horn needs adjusting.

4. Weak strained tone - foreigh body in horn trumpet that should be shaken out or removed.

5. Harsh vibration - caused by horn touching sheet metal. Bracket should be bent to give horn clearance and freedom from interference.

c. Horn Blows Constantly

1. This can be caused by sticking horn contacts in the relay.

2. Horn relay may be energized by grounded or shorted wiring.

(NOTE: Burned open windings on most horns are caused by one of the above malfunctions. Before horns with open windings are replaced by new horns, make sure that none of the above conditions exist, or the horn windings will again burn open.)

d. Bench Checks

1. Measure current draw of horn while horn is operating. Current draw for each horn should be between 4.5 and 5.5 amperes at 11.5 to 12.5 volts.

2. No current may indicate a broken connection or an open circuit due to a broken lead or to overheating. Most horn failures are caused by horns being operated continuously, which develops sufficient heat to melt the wires in the winding, causing an open circuit. Overheating is accompanied by a characteristic odor which indicates that horn should be replaced.

3. No current can also indicate that the contact points are open and a current adjustment is required. Turn adjusting screw counterclockwise.

4. High current, over 20 amperes, indicates an overheated winding or shorted horn which should be replaced.

5. A reading of approximately 18 amperes for a 12-volt horn indicates a condition in which the contact points are not opening. A current adjustment is required by turning the adjusting screw clockwise.

e. Current Adjustment

Turn adjusting screw, Fig. 12-18 counterclockwise to increase current or clockwise to decrease current until specified current is reached. Care must be taken not to turn the adjusting screw too far. Turn screw 1/4 of a turn at one time. If adjustment loosens the screw excessively, it may be staked with a punch.

f. Cold Weather Adjustment

If horn fails to blow in cold weather, it is possible that current limit is set too low although still within 4.5 - 5.5 ampere limit (each horn) at 12.0 volts. Turn adjusting screw 1/4 turn counterclockwise (90°) to increase draw, Fig. 12-18.

CAUTION: This adjustment should not be made unless horn fails to blow. A current increase on a properly operating horn can result in complete failure of unit.

31. Clock Regulation and Resetting

The accuracy of automobile clocks operating on direct current should not be compared too closely with that of electric clocks operating on alternating current. The frequency of alternating current is controlled and corrected constantly at the power source, thereby eliminating accumulation of errors. A car clock is spring-operated and electrically wound. Time errors are accumulated day by day.

An automobile clock is considered a good time piece when at normal temperatures the consistent gain or loss does not exceed two minutes per day.

The owner must anticipate resetting the hands occasionally. This should be explained to owners at new car delivery. It is possible to regulate the clock so that the variation will be less than two minutes a day if care is taken as described below.

The reset knob projects from the center of the lower edge of the clock. To reset, push reset knob all the way in and turn until hands are at desired time. Keep the

reset knob fully pushed in during adjustment, otherwise, automatic regulator may not engage. Resetting clock in either direction will automatically regulate clock to run approximately 20 seconds per day faster or slower, depending on which way clock is set. Resetting the clock slower does not harm the clock in any way. If more than a 20 second adjustment is required, resetting the clock after 6 hours have elapsed will give an additional 20 second slower or faster regulation per day.

The special oils used to lubricate automotive clocks tend to deteriorate with age. If timekeeping characteristics of the clock become erratic, it should be removed and sent to the clock manufacturer's authorized clock repair station for cleaning and re-oiling. Cleaning and re-oiling is recommended at least once every two years.

32. Back-Up Light and Neutral Switch Adjustment

Check transmission linkage adjustment as described in Section 7, Note 4, on all but 693 style or Note 21 on 693 style before adjusting switch.

1. Switch should operate as described below:

a. Engine should start in PARK and NEUTRAL positions only.

b. Back-up lights should operate when transmission shift lever is placed in REVERSE position.

c. Parking brake should release in any drive range with engine running.

A vacuum leak that can be corrected by moving the shift lever is an indication that the switch is improperly adjusted and not defective. The switch should be adjusted in this situation. Adjust as described below:

2. Loosen screw on clamp securing switch to steering column.

3. Place transmission shift lever in NEUTRAL detent.

4. Adjust switch until engine starts in NEUTRAL detent. Tighten clamp screw and test operation as described in step 1.

SERVICE INFORMATION

33. Fuel Tank Float Unit

a. Removal

1. Remove fuel tank as described in Section 8, Note 2.

2. Remove locknut securing fuel gage tank unit and remove wire from tank unit.

3. Remove five screws and six washers securing gage tank unit to tank and lift out of tank. Discard gasket.

b. Installation

1. Install gage tank unit in fuel tank, using new gasket, and install four mounting screws and washers at all holes except ground. At ground screw hole, position washer, ground wire and second washer, securing with screw.

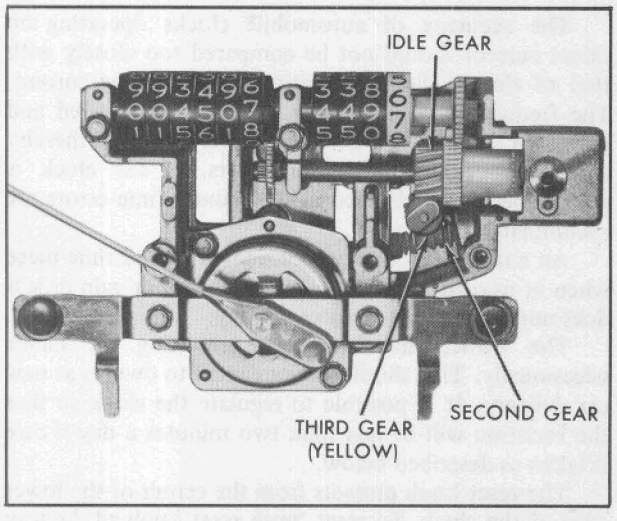


Fig. 12-19 Speedometer Head Assembly

2. Connect fuel gage wire to gage tank unit and secure with attaching locknut.

3. Install fuel tank as described in Section 8, Note 2.

34. Speedometer Head Assembly (Fig. 12-19)

a. Disassembly

1. Remove speedometer head assembly as described in Note 50a.

(NOTE: Do not attempt to disassemble the odometer wheel assembly. It is serviced as a complete unit.)

2. Lift out trip odometer with end spring on left side of shaft and interconnecting gear on right side.

3. Remove idler gear, trip odometer reset gear, bushing and odometer engaging spring by lifting shaft slightly on left and pulling out to remove.

4. Remove third gear retainer plate screw and plate, then remove trip odometer reset spring.

5. Remove odometer reset shaft.

6. With the third gear retainer plate screw and plate off, lift out yellow third gear.

(NOTE: Further disassembly requires removal of field plate and speed cup assembly and subsequent recalibration of speedometer. If speedometer tester is not available for recalibration, repairs needing disassembly beyond this point should be referred to your designated speedometer service station.)

7. Carefully remove white painted aluminum pointer assembly (press fit). Turn against zero stop and lightly lift pointer assembly at hub.

8. Remove two screws securing jewel plate. Remove jewel plate.

9. Remove two screws securing field plate to frame and remove field plate and speed cup by lifting out by the speed cup spindle.

10. Inspect second gear for signs of damage. Do not remove unless necessary, as this gear will usually break while being removed. If necessary, remove second gear as follows:

a. Place bushing side of frame on wood block, but be certain bushing area is not obstructed by wood block.

b. Insert 1/8" punch or rod inside frame and against rear of bushing.

c. Carefully drive out bushing.

(NOTE: Further disassembly, such as removal of the magnet shaft from frame and speed cup assembly is not recommended.)

b. Assembly

1. If removed, position second gear in frame assembly with gear end contacting worm gear on magnet shaft. Install by tapping bushing squarely into frame with rawhide mallet or similar tool until end play is .005" to .025".

2. Position third (yellow) gear with bevel gear end engaging worm gear end on second gear.

3. Install trip odometer reset shaft, position reset shaft return spring so that spring is actuated when shaft is depressed.

4. Holding spring in position, install retainer plate and screw, being sure second gear is in plate hole.

5. Position shaft containing idler gear, trip odometer reset gear and odometer engaging spring in frame, engaging right end into frame hole first.

6. Make sure trip odometer is clean of fingerprints by wiping with a lintless cloth or soft chamois.

7. Install trip odometer with end spring and interconnecting gear, making sure slotted cars of pinion carriers fit in positioning slot in frame.

8. Wipe total odometer clean of fingerprints with a lintless cloth or soft chamois.

9. Install total odometer, making sure slotted ears of pinion carriers fit in position slot in tear out plastic locator.

10. If removed, install speed cup and field plate by holding speed cup spindle and guiding assembly onto dowels. Retain with two screws and tighten uniformly.

(NOTE: Make sure speed cup stop tab is on correct side of field plate so as to permit needle rotation. Hairspring coil on speed cup must be evenly spaced when in wound position. It may be necessary to use tweezers to adjust coils. Move regulator arm to horizontal position, if necessary, so that maximum adjustment may be made in either direction during calibration.)

11. If removed, install jewel plate with cup end down. Place one drop of rislone-type oil in jewel. Carefully wipe off excess oil.

12. Rotate all odometer wheels to the top of their travel.

13. Mount pointer on tapered spindle so that it points at approximately 30 MPH. Install speedometer mechanism to plastic dial. Twist pointer back to, and in line with, "O" graduation while pressing down lightly.

14. Check for secure pointer to spindle contact by inserting a short piece of speedometer cable with proper tip in drive end of speedometer. An initial fast spin of test cable should swing pointer to approximately 30 MPH and then briskly return to "O". Perform this test several times. If pointer becomes loose on spindle, repeat step 13.

15. If during the performance of step 14, pointer returns to "O" intermittently or not at all this indicates a speed cup and magnet assembly defect.

16. If field plate and speed cup assembly were removed, calibrate speedometer assembly, following the instructions furnished by the manufacturer for the speedometer tester being used.

17. Install speedometer head assembly as described in Note 50b.

35. Directional Signal Switch and Hazard Warning Switch

a. Removal

1. Disconnect negative battery cable.

2. Remove directional signal switch and hazard warning switch as described in Section 9, Note 20a.

b. Installation

1. Install directional signal switch and hazard warning switch as described in Section 9, Note 20f.

2. Connect negative battery cable.

36. Horn Contact Assembly

a. Removal

1. Remove three screws from back of spokes and lift pad assembly from wheel.

2. Remove horn contact wire from plastic tower by pushing in on wire and turning counterclockwise. Wire will then spring out of tower.

b. Installation

1. Insert horn contact wire into plastic tower by pushing in against spring pressure and turning to the right to lock in position.

2. Position pad assembly on wheel and secure with three screws from underside of wheel.

37. Back-Up Light and Neutral Switch (Fig. 12-20)

The neutral switch, back-up light switch, and parking brake vacuum release valve are combined into one unit mounted on the steering column under the instrument panel

a. Removal

1. Place transmission shift lever in NEUTRAL detent.

2. Remove screw in clamp and carefully remove switch and clamp from steering column, being careful not to disturb position of contact carrier.

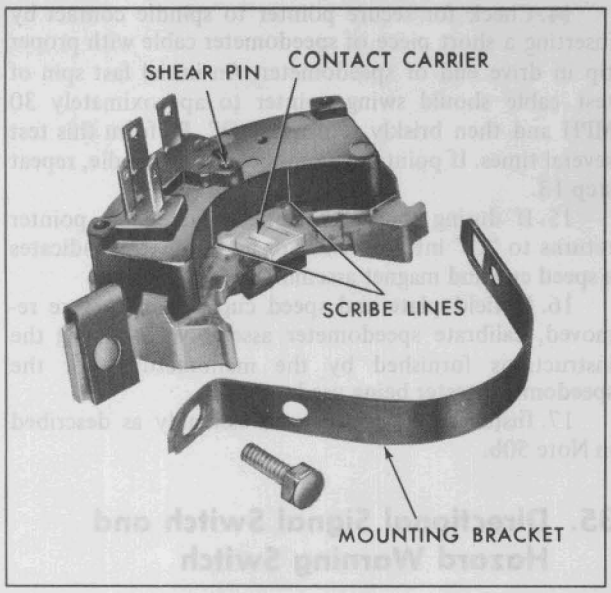


Fig. 12-20 Back-Up and Neutral Switch

3. Mark position of contact carrier, Fig. 12-20.
4. Mark top vacuum hose for identification and remove hoses.
5. Disconnect two wiring connectors from switch.

b. Installation

1. Place transmission shift lever in NEUTRAL detent.
2. Connect two wiring connectors to switch.
3. Move contact carrier on switch assembly to neutral position as marked during removal, Fig. 12-20. If necessary to install a new switch, the switch will be secured in neutral by a shear pin. Do not break pin.
4. Install switch assembly on steering column, aligning contact carrier blade with slot in shift tube. With switch tight against column, slide switch down column until bosses on casting rest on bottom edge of slot in outer jacket. Bosses extend below the mounting surface.
5. Place clamp on switch and install screw to tighten clamp, making sure that shift lever is in NEUTRAL detent while this operation is performed.
6. Connect vacuum hoses to switch as marked during removal.
7. Switch should now be properly adjusted. If new switch was installed, a slightly greater effort to position the shift lever in any position besides neutral will be necessary, because it will be necessary to break the shear pin. Check operation as described in step 1 of Note 32.

38. Electrical Accessory Installation

When installing additional electrical equipment, such as Rear Window Defogger or Twilight Sentinel, connect this equipment to the proper terminals in the wiring harness or the accessory terminal on the fuse panel in accordance with the instructions provided with the accessory. Care should be exercised in installing accessories other than those that are Cadillac designed to avoid over-loading the electrical system.

GENERAL INFORMATION

INSTRUMENT PANEL

The instrument panel for 1972 is illustrated in Fig. 12-21. The service information portion of this section includes procedures for the removal and installation of all components that can be considered a part of, or attached to, the instrument panel assembly.

The procedures for actual disassembly, assembly, testing, or adjustment of the various components are covered in specific sections of this manual where they apply.

The starter switch is combined with the steering column and shift lever lock, located on the right side of the steering column below the steering wheel, and is mechanically connected to the ignition switch located on the steering column jacket below the instrument panel. Fig. 12-22.

The engine is started by turning the key clockwise against spring tension to energize the starter solenoid. When the engine starts, releasing the key permits it to return to the "RUN" position. All accessories (except Twilight Sentinel) are disconnected in the "START" position.

The ignition lock has five key positions – "ACCESSORY" – "LOCK" – "OFF" – "RUN" – and "START". The "LOCK" position is clearly marked on the left side of the lock cylinder and is coordinated with the pointer on the ignition knob. The transmission shift lever must be in "PARK" position and the ignition knob in "LOCK" position before the key can be inserted or removed. This locks the steering wheel and transmission shift lever as well as the ignition system.

The "OFF" position allows the engine to be shut off without locking the steering wheel or transmission shift lever, so that the car can be steered or towed in case of any problem requiring turning off the ignition. The "RUN" position completes the ignition circuit and activates all instruments and accessories.

The "ACCESSORY" position allows the use of accessories with the ignition off.

The switch also features a buzzer system to warn the driver to remove the key from the lock. If the driver's door is opened with the key in the lock and the switch in the "OFF", "LOCK", or "ACCESSORY" position, a relay buzzes and the Engine Temperature Warning light is Illuminated as a reminder that the key has not been removed from the lock.

The fuse panel, Fig. 12-23, is mounted on the cowl under the instrument panel to the left of the steering column.

The following fuses are located in this panel: cigar lighters, clock, courtesy lights, glove box, light, map light, chauffeur light on 697 styles, trunk light, ash tray light, cornering, parking, and front side marker lights, back-up lights, Cruise Control lights, turn signals, rear window defogger, transmission downshift solenoid, fuel gage, tell-tale lights, heater and air conditioner, instrument panel lights, radio, stop lights and Hazard Warning flasher, tail lights, license light, and windshield wipers and washer.

Two circuit breakers are provided in the fuse panel, one for convertible top, horns, power seat and power door locks and one for power windows. The Hazard Warning Flasher is located on the fuse block, while the turn signal flasher is located on the rear side of the steering column lower cover.

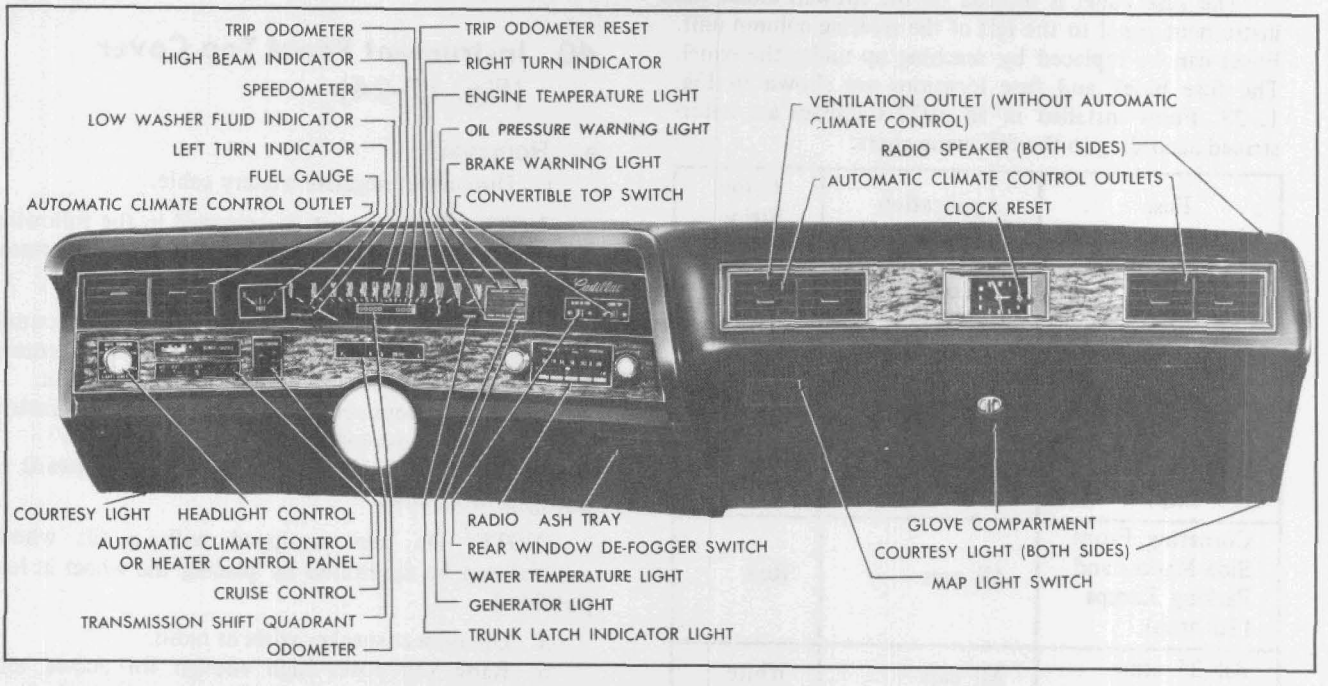


Fig. 12-21 Instrument Panel Assembly

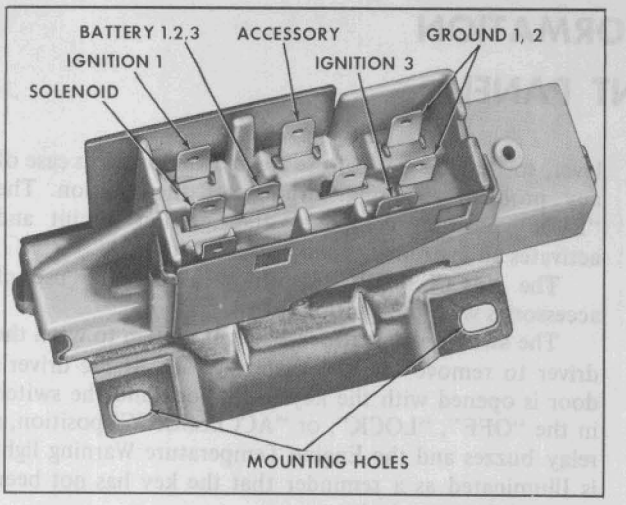


Fig. 12-22 Ignition Switch

The chassis wiring diagrams are illustrated at the end of this section. To simplify removal and installation for service replacement, the major portion of chassis wiring is divided into four separate harnesses: the forward lamp harness, engine harness dash harness and the instrument panel harness. These harnesses are protected by fusible links in the wiring and fuses and circuit breakers in the fuse panel.

Fusible links are placed in the power feed circuits in the engine compartment, and are designed to open up before the instrument panel or body feed wiring, ahead of the fuse panel, is damaged in case of shorts.

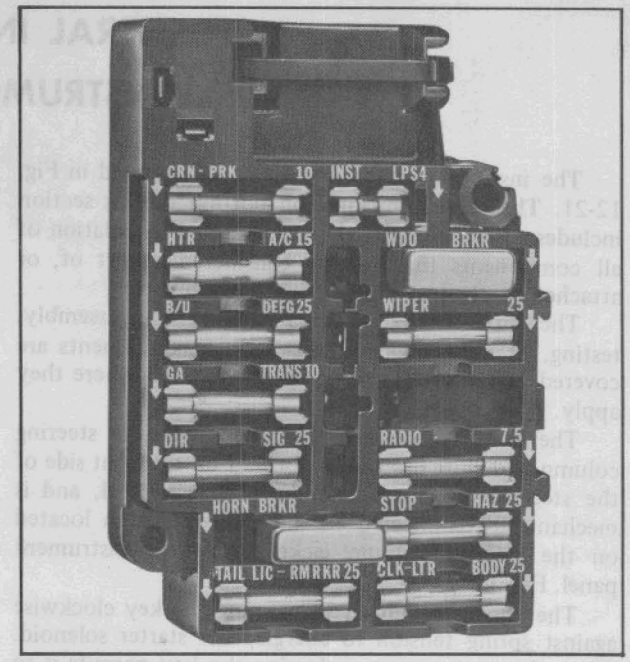


Fig. 12-23 Fuse Panel

All 1972 instrument panels utilize a printed circuit on the back of the instrument panel cluster assembly. It is connected to the car wiring through a multiple terminal connector which is plugged into the back side of the cluster. The printed circuit permits removal of all bulbs and sockets without any wire or terminal removal.

SERVICE INFORMATION

39. Fuse Replacement

The fuse panel is located on the firewall under the instrument panel to the left of the steering column unit. Fuses can be replaced by reaching up under the panel. The fuse block and fuse locations are shown in Fig. 12-23. Fuses installed in all 1972 Cadillacs are color-striped according to the following chart:

Fuse	Application	Color Stripe
Heater and Air Conditioner (15 amp)	All except 697	Lt. Blue
Radio (7-1/2 amp)	All cars	Brown
Trans. and Instruments (10 amp)	All cars	Red
Cornering, Front Side Marker and Parking Lamps (10 amp)	All cars	Red
All 25 amp Fuses	All cars	White

For Service replacement, unstriped common fuses of same amperage and size can be used.

40. Instrument Panel Top Cover (Fig. 12-24)

a. Removal

1. Disconnect negative battery cable.

(NOTE: Screws must be removed in the following sequence to prevent damage to plastic bosses if stresses are present in panel.)

2. Open glove box and remove two screws securing top cover to instrument panel. On A/C cars, remove aspirator hose from sensor through top of glove box.
3. Remove four screws securing top cover to instrument panel bezel assembly.
4. Lift up lightly and pull top cover rearward to disengage from cowl.

(NOTE: On cars equipped with a tilt wheel, removal can be facilitated by placing the wheel in low position.)

5. Disconnect speaker wires at radio.
6. Raise top cover high enough for access, and disconnect twilight sentinel photocell at left front

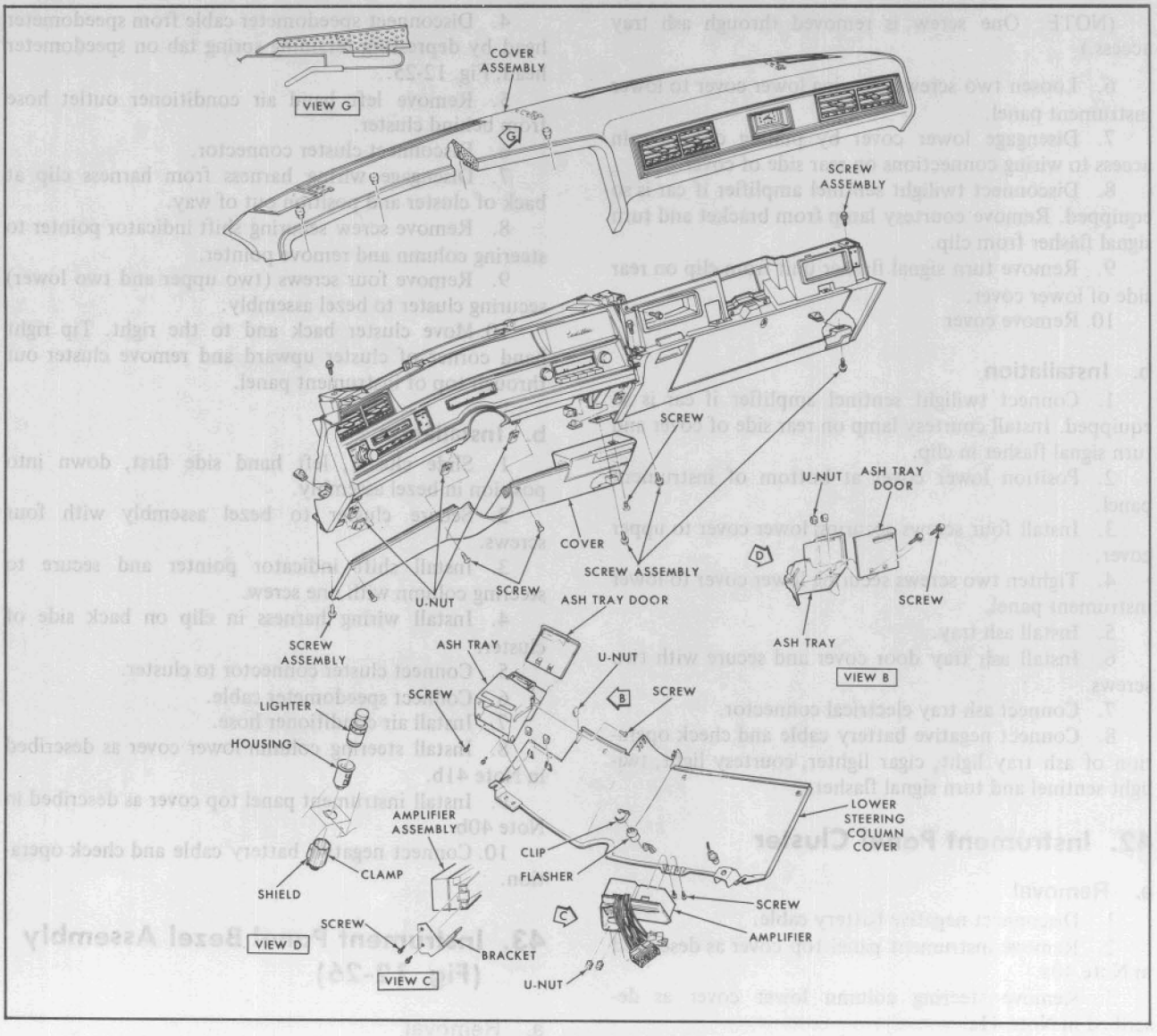


Fig. 12-24 Instrument Panel Cover Disassembled

speaker opening and sensor harness connector from sensor if car is so equipped, also clock electrical feed wires and lamp assembly.

7. Remove instrument panel top cover.

b. Installation

1. Hold top cover over instrument panel and connect clock feed wires and lamp assembly, also twilight sentinel photocell and sensor harness connector if car is so equipped.

2. Connect front speaker wires at radio.

3. Position top cover on panel so that three clips engage at windshield and align screw holes in bezel and glove box.

(NOTE: Screws must be installed in the following sequence to prevent damage to plastic bosses if stresses are present in panel.)

4. Install four screws securing top cover to instrument panel bezel assembly.

5. Working inside of glove box, install two screws securing top cover to instrument panel. On A/C cars, install aspirator hose.

6. Connect negative battery cable and check operation of clock, clock light, front radio speakers and twilight sentinel.

41. Steering Column Lower Cover (Fig. 12-24)

a. Removal

1. Disconnect negative battery cable at battery.

2. Disconnect ash tray electrical connector.

3. Push ash tray out and remove two Phillips head screws at bottom of ash tray. Remove ash tray door cover.

4. Remove ash tray.

5. Remove four screws securing lower cover to upper cover.

(NOTE: One screw is removed through ash tray access.)

6. Loosen two screws securing lower cover to lower instrument panel.
7. Disengage lower cover by pulling out to gain access to wiring connections on rear side of cover.
8. Disconnect twilight sentinel amplifier if car is so equipped. Remove courtesy lamp from bracket and turn signal flasher from clip.
9. Remove turn signal flasher unit from clip on rear side of lower cover.
10. Remove cover

b. Installation

1. Connect twilight sentinel amplifier if car is so equipped. Install courtesy lamp on rear side of cover and turn signal flasher in clip.
2. Position lower cover at bottom of instrument panel.
3. Install four screws securing lower cover to upper cover.
4. Tighten two screws securing lower cover to lower instrument panel.
5. Install ash tray.
6. Install ash tray door cover and secure with two screws.
7. Connect ash tray electrical connector.
8. Connect negative battery cable and check operation of ash tray light, cigar lighter, courtesy light, twilight sentinel and turn signal flasher.

42. Instrument Panel Cluster

a. Removal

1. Disconnect negative battery cable.
2. Remove instrument panel top cover as described in Note 40a.
3. Remove steering column lower cover as described in Note 41a.

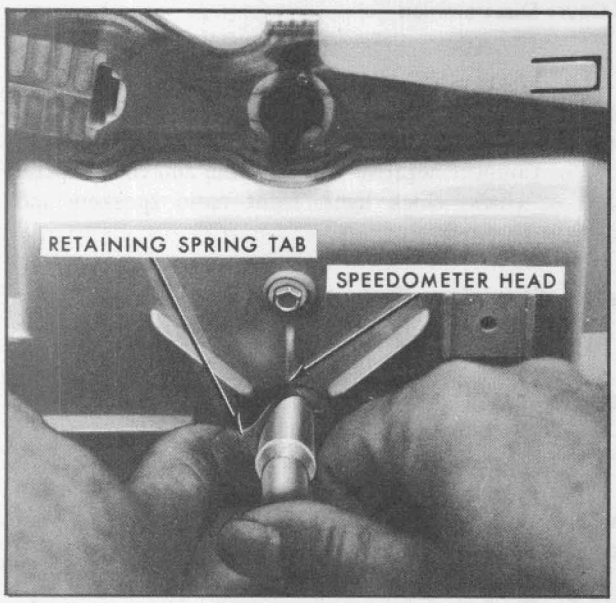


Fig. 12-25 Speedometer Cable

4. Disconnect speedometer cable from speedometer head by depressing retaining spring tab on speedometer head, Fig. 12-25.
5. Remove left hand air conditioner outlet hose from behind cluster.
6. Disconnect cluster connector.
7. Disengage wiring harness from harness clip at back of cluster and position out of way.
8. Remove screw securing shift indicator pointer to steering column and remove pointer.
9. Remove four screws (two upper and two lower) securing cluster to bezel assembly.
10. Move cluster back and to the right. Tip right hand corner of cluster upward and remove cluster out through top of instrument panel.

b. Installation

1. Slide cluster, left hand side first, down into position in bezel assembly.
2. Secure cluster to bezel assembly with four screws.
3. Install shift indicator pointer and secure to steering column with one screw.
4. Install wiring harness in clip on back side of cluster.
5. Connect cluster connector to cluster.
6. Connect speedometer cable.
7. Install air conditioner hose.
8. Install steering column lower cover as described in Note 41b.
9. Install instrument panel top cover as described in Note 40b.
10. Connect negative battery cable and check operation.

43. Instrument Panel Bezel Assembly (Fig. 12-26)

a. Removal

1. Disconnect negative battery cable.
2. Remove instrument panel top cover as described in Note 40a.
3. Remove steering column lower cover as described in Note 41a.
4. Remove radio as described in Note 57a.
5. Remove screw securing shift indicator pointer to steering column and remove pointer.
6. Remove air conditioner hose from behind cluster.
7. Disconnect wiring harness at top and bottom of bezel.
8. Remove wiring harness from back of cluster.
9. Disconnect speedometer cable from speedometer head by depressing spring tab on speedomter, Fig. 12-25.
10. Disconnect the following electrical and vacuum connections, depending on car equipment.
    a. Vacuum connector, electrical connectors and light on Climate Control Panel.
    b. Wiring connector and two lights at headlight switch.
    c. Twilight Sentinel connector.
    d. Guide Matic connector.

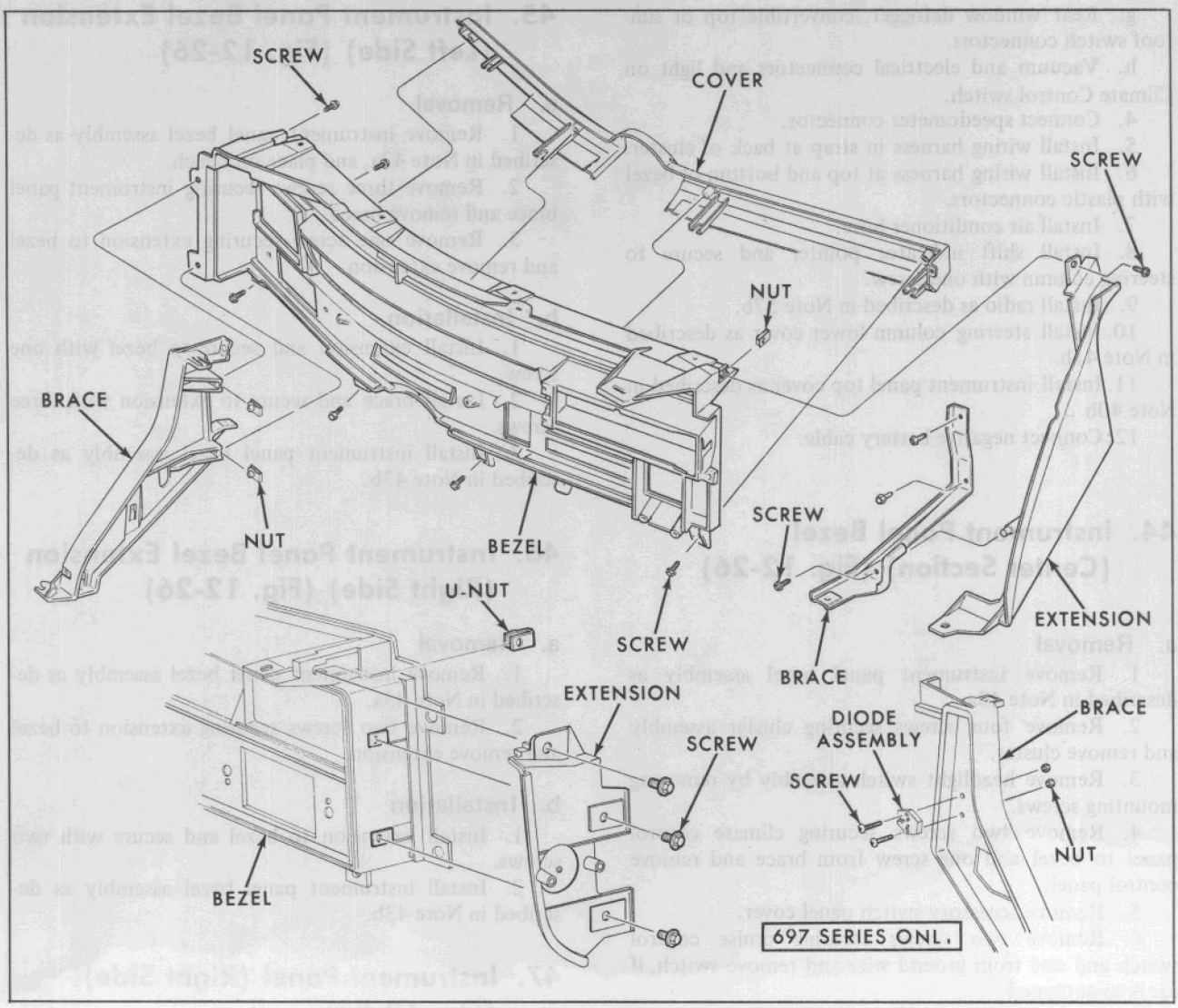


Fig. 12-26 Instrument Panel—Bezel

e. Rear window de-fogger, convertible top or Sunroof switch connectors.

f. Wiring connector and light to cruise control switch.

g. Two ground wires on left side of bezel.

h. Instrument panel cluster connector.

11. Remove the following screws, Fig. 12-26:

a. Four screws securing steering column upper cover to bezel assembly and remove upper cover.

b. Two screws securing bezel assembly to instrument panel center support.

c. Screw securing bezel assembly to instrument panel frame above left air conditioner duct.

d. Screw securing bezel assembly to instrument panel frame under headlight switch.

12. Using care to avoid damage, remove bezel assembly by lifting upward and working right side free from instrument panel.

(NOTE: See Notes 44, 45, and 46, when replacing any part of the bezel assembly.)

b. Installation

1. Install bezel into instrument panel.

2. Install the following screws, Fig. 12-26:

a. Screw securing bezel to instrument panel frame under headlight switch.

b. Screw securing bezel to instrument panel frame above left air conditioner duct.

c. Two screws securing bezel to instrument panel center support.

d. Install steering column upper cover and secure with four screws.

3. Install the following electrical and vacuum circuits depending on car equipment.

a. Instrument panel cluster connector.

b. Two ground wires on left side of bezel.

c. Wiring connector and light to Cruise Control switch.

d. Guide-Matic connector.

e. Twilight Sentinel connector.

f. Connector and two lights at headlight switch.

g. Rear window defogger, convertible top or sunroof switch connectors.

h. Vacuum and electrical connectors and light on Climate Control switch.

4. Connect speedometer connector.

5. Install wiring harness in strap at back of cluster.

6. Install wiring harness at top and bottom of bezel with plastic connectors.

7. Install air conditioner hose.

8. Install shift indicator pointer and secure to steering column with one screw.

9. Install radio as described in Note 57b.

10. Install steering column lower cover as described in Note 41b.

11. Install instrument panel top cover as described in Note 40b.

12. Connect negative battery cable.

44. Instrument Panel Bezel (Center Section) (Fig. 12-26)

a. Removal

1. Remove instrument panel bezel assembly as described in Note 43a.

2. Remove four screws securing cluster assembly and remove cluster.

3. Remove headlight switch assembly by removing mounting screws.

4. Remove two screws securing climate control panel to bezel and one screw from brace and remove control panel.

5. Remove accessory switch panel cover.

6. Remove two screws securing cruise control switch and one from ground wire and remove switch, if car is so equipped.

7. Remove two screws securing conditioner duct to bezel and remove duct.

8. Remove left extension as described in Note 45a.

9. Remove right extension as described in Note 46a.

b. Installation

1. Install right extension as described in Note 46b.

2. Install left extension as described in Note 45b.

3. Install air conditioner duct and secure with two screws.

4. Install cruise control switch and secure with two screws connecting ground wire with one screw.

5. Install accessory switch panel cover by sliding right side of switch panel into opening and pushing left side in.

6. Install climate control panel to bezel and secure with two screws and one screw in brace.

7. Install headlight switch assembly and secure with mounting screws.

8. Install cluster assembly and secure with four screws.

9. Install instrument panel bezel assembly as described in Note 43b.

45. Instrument Panel Bezel Extension (Left Side) (Fig. 12-26)

a. Removal

1. Remove instrument panel bezel assembly as described in Note 43a, and place on bench.

2. Remove three screws securing instrument panel brace and remove brace.

3. Remove one screw securing extension to bezel and remove extension.

b. Installation

1. Install extension and secure to bezel with one screw.

2. Install brace and secure to extension with three screws.

3. Install instrument panel bezel assembly as described in Note 43b.

46. Instrument Panel Bezel Extension (Right Side) (Fig. 12-26)

a. Removal

1. Remove instrument panel bezel assembly as described in Note 43a.

2. Remove two screws securing extension to bezel and remove extension.

b. Installation

1. Install extension to bezel and secure with two screws.

2. Install instrument panel bezel assembly as described in Note 43b.

47. Instrument Panel (Right Side) (Fig. 12-27)

a. Removal

1. Disconnect negative battery cable.

2. Remove instrument panel top cover as described in Note 40a.

3. Remove air conditioner hose from right hand duct and boot from center duct.

4. Remove the following electrical wiring connections and connectors:

a. Wiring harness from harness clips at top of panel.

b. Glove box lamp and harness.

c. Courtesy lamp from mounting bracket.

d. Map light connector.

e. If car is equipped with a remote control trunk lock, open glove box and remove trunk lock switch from glove box housing.

5. Remove the following screws:

a. Three screws securing right hand panel to center support.

b. One screw securing panel to right hand top mounting bracket.

c. One screw securing panel to right hand lower mounting bracket.

6. Remove right hand instrument panel.

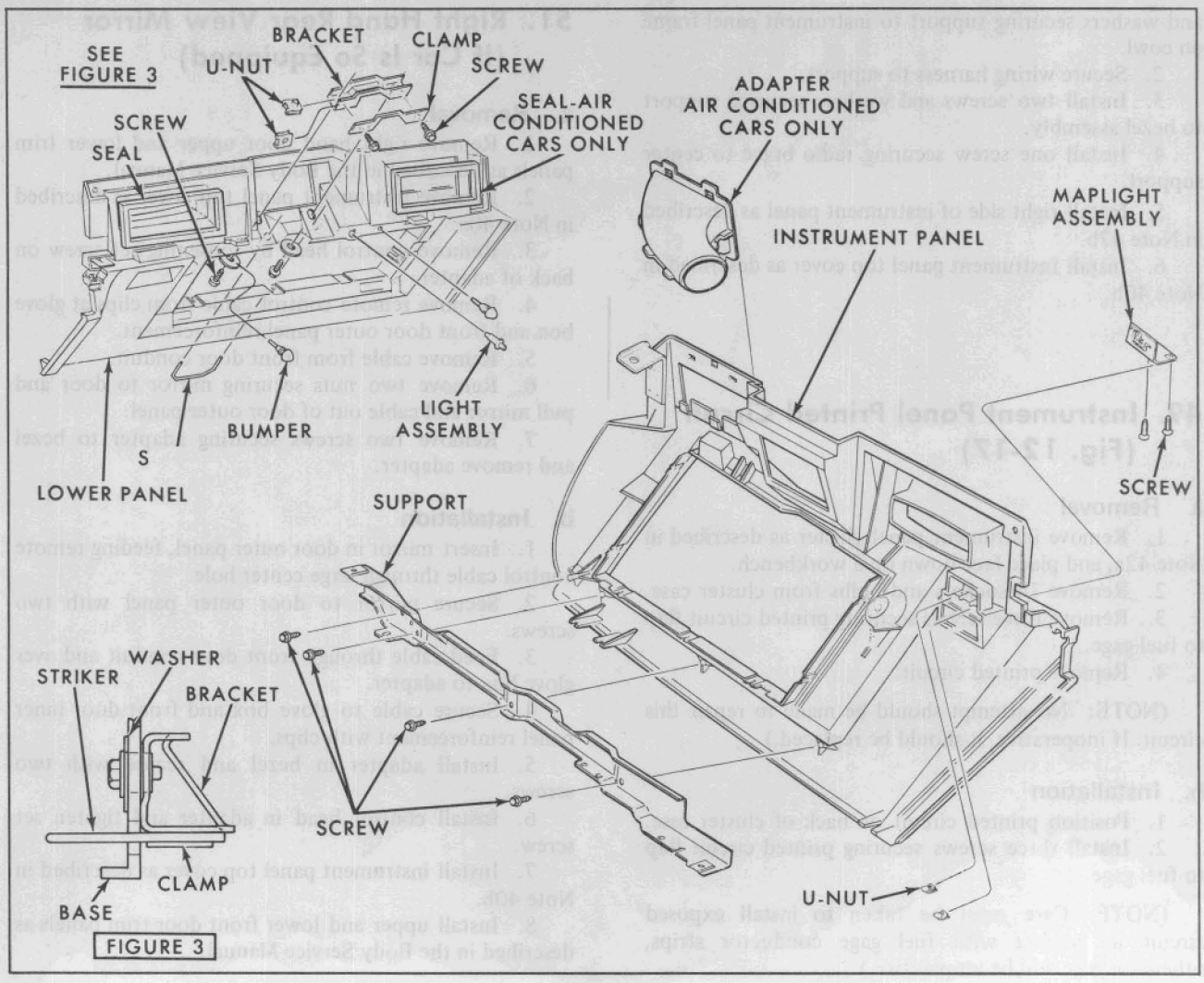


Fig. 12-27 Instrument Panel—Right Side

b. Installation

1. Position panel in place and install the following screws.

a. One screw securing panel at right hand upper mounting bracket.

b. One screw securing panel at right hand lower mounting bracket.

c. Three screws securing panel to center support.

2. Install the following electrical wiring connections and connectors:

a. Glove box lamp and harness.

b. Courtesy lamp in mounting bracket.

c. Map light lamp connector.

d. Wiring harness in clips at top of panel.

e. If car is equipped with a remote control trunk lock, install lock switch in glove box housing.

3. Install air conditioner hose to right hand duct and boot to center duct.

4. Install instrument panel top cover as described in Note 40b.

5. Connect negative battery cable.

48. Instrument Panel Center Support

a. Removal

1. Remove instrument panel top cover as described in Note 40a.

2. Remove right side of instrument panel as described in Note 47a.

3. Remove two screws and washers securing support to bezel assembly.

4. Remove three screws and washers securing support to instrument panel frame on firewall.

5. Remove one screw securing radio brace to center support.

6. Pull wiring harness and radio ground strap away from support and remove support.

b. Installation

1. Put support in position and install two screws

and washers securing support to instrument panel frame on cowl.

2. Secure wiring harness to support.

3. Install two screws and washers securing support to bezel assembly.

4. Install one screw securing radio brace to center support.

5. Install right side of instrument panel as described in Note 47b.

6. Install instrument panel top cover as described in Note 40b.

49. Instrument Panel Printed Circuit (Fig. 12-17)

a. Removal

1. Remove instrument panel cluster as described in Note 42a, and place face down on a workbench.

2. Remove 14 sockets and bulbs from cluster case.

3. Remove three screws securing printed circuit flap to fuel gage.

4. Remove printed circuit.

(NOTE: No attempt should be made to repair this circuit. If inoperative, it should be replaced.)

b. Installation

1. Position printed circuit on back of cluster case.

2. Install three screws securing printed circuit flap to fuel gage.

(NOTE: Care must be taken to install exposed circuit in contact with fuel gage conductor strips, otherwise gage will be inoperative.)

3. Install 14 sockets and bulbs into cluster case.

4. Install instrument panel cluster assembly as described in 42b.

50. Speedometer Head Assembly

a. Removal

1. Remove cluster assembly as described in Note 42a.

2. Working on bench remove seven screws securing back case to dial assembly.

3. Remove three screws securing printed circuit to fuel gage and remove gage.

4. Remove two nuts securing speedometer head assembly to dial assembly.

5. Slide speedometer head assembly out from lens assembly being careful not to damage pointer.

b. Installation

1. Slide speedometer head assembly into lens assembly and secure with two nuts.

2. Install back case to dial assembly and secure with eight screws.

3. Install fuel gage and secure printed circuit to gage with three screws.

4. Install cluster assembly as described in Note 42b.

51. Right Hand Rear View Mirror (If Car Is So Equipped)

a. Removal

1. Remove right hand door upper and lower trim panels as described in the Body Service Manual.

2. Remove instrument panel top cover as described in Note 40a.

3. Remove control head by loosening set screw on back of adapter.

4. Remove remote control cable from clips at glove box and front door outer panel reinforcement.

5. Remove cable from front door conduit.

6. Remove two nuts securing mirror to door and pull mirror and cable out of door outer panel.

7. Remove two screws securing adapter to bezel and remove adapter.

b. Installation

1. Insert mirror in door outer panel, feeding remote control cable through large center hole.

2. Secure mirror to door outer panel with two screws.

3. Feed cable through front door conduit and over glove box to adapter.

4. Secure cable to glove box and front door inner panel reinforcement with clips.

5. Install adapter in bezel and secure with two screws.

6. Install control head in adapter and tighten set screw.

7. Install instrument panel top cover as described in Note 40b.

8. Install upper and lower front door trim panels as described in the Body Service Manual.

52. Clock Assembly

a. Removal

1. Disconnect negative battery cable.

2. Remove right and center air conditioner grilles as described in Note 66a.

3. Loosen two screws in each outlet.

4. Pull right hand instrument panel insert out from instrument panel.

5. Disconnect electrical feed wires and two lamp assemblies; remove insert.

6. Remove two mounting screws from back of insert and remove clock.

b. Assembly

1. Install clock in insert and secure with two mounting screws.

2. Connect electrical feed wires and two lamp assemblies.

3. Install right hand instrument panel insert and tighten two screws in each air conditioner outlet.

4. Install air conditioner grilles as described in Note 66b.

5. Connect negative battery cable.

(NOTE: Servicing clock illumination lamps can be achieved without removing clock by reaching up through

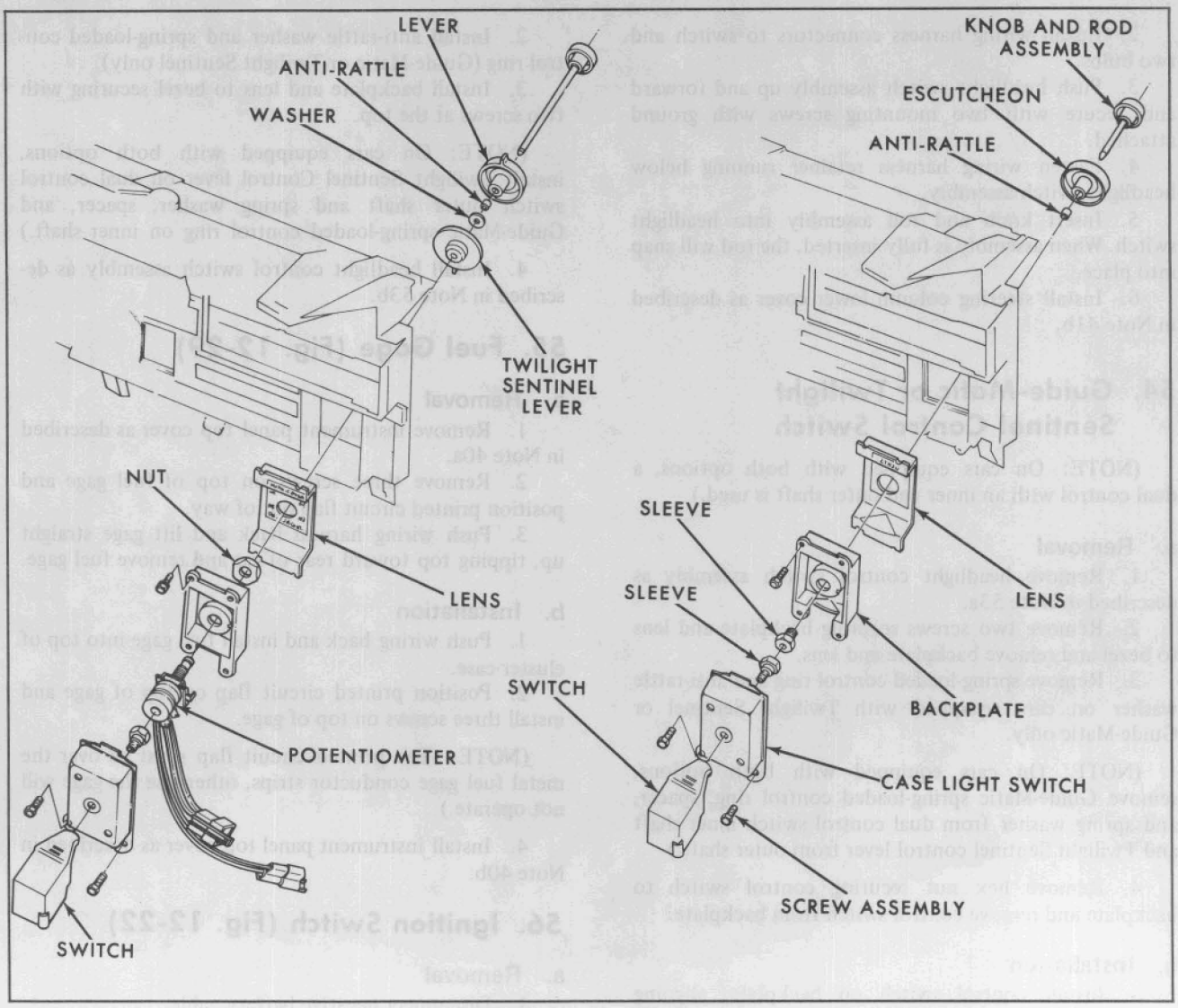


Fig. 12-28 Light Switch—Disassembled

opening in top of glove box liner and removing lamp sockets.)

53. Headlight Control Switch Assembly (Fig. 12-28)

a. Switch Removal

1. Remove steering column lower cover as described in Note 41a.
2. Unfasten wiring harness retainer running below headlight switch assembly.
3. Depress spring loaded release button on top of headlight switch and remove headlight switch knob and rod assembly.
4. Remove two mounting screws with ground wire located at bottom of switch housing.
5. Pull headlight switch assembly down and rearward, disconnect wiring harness connectors, two bulbs and remove assembly.
6. Remove hex head sleeve securing headlight switch to housing case and remove switch from case.

b. Backplate and Lens Removal

(NOTE: On cars equipped with Guide-Matic or Twilight Sentinel, refer to Note 54a.)

1. Remove two screws securing lens and backplate to bezel and remove lens.
2. Remove hex head sleeve securing backplate to lens, washer and escutcheon and separate these parts.

c. Backplate and Lens Installation

(NOTE: On cars equipped with Guide-Matic or Twilight Sentinel, refer to Note 54b.)

1. Position lens, washer and escutcheon on backplate and secure with hex head sleeve.
2. Install lens and backplate assembly to bezel. Secure with two screws at top of backplate.

d. Switch Installation

1. Install headlight switch to housing case and secure with hex head sleeve.

2. Install wiring harness connectors to switch and two bulbs.

3. Push headlight switch assembly up and forward and secure with two mounting screws with ground attached.

4. Fasten wiring harness retainer running below headlight switch assembly.

5. Insert knob and rod assembly into headlight switch. When assembly is fully inserted, the rod will snap into place.

6. Install steering column lower cover as described in Note 41b.

54. Guide-Matic or Twilight Sentinel Control Switch

(NOTE: On cars equipped with both options, a dual control with an inner and outer shaft is used.)

a. Removal

1. Remove headlight control switch assembly as described in Note 53a.

2. Remove two screws securing backplate and lens to bezel and remove backplate and lens.

3. Remove spring-loaded control ring and anti-rattle washer on cars equipped with Twilight Sentinel or Guide-Matic only.

(NOTE: On cars equipped with both options, remove Guide-Matic spring-loaded control ring, spacer, and spring washer from dual control switch inner shaft and Twilight Sentinel control lever from outer shaft.)

4. Remove hex nut securing control switch to backplate and remove control switch from backplate.

b. Installation

1. Install control switch on backplate, aligning notch in backplate with tang on control switch. Secure with hex nut.

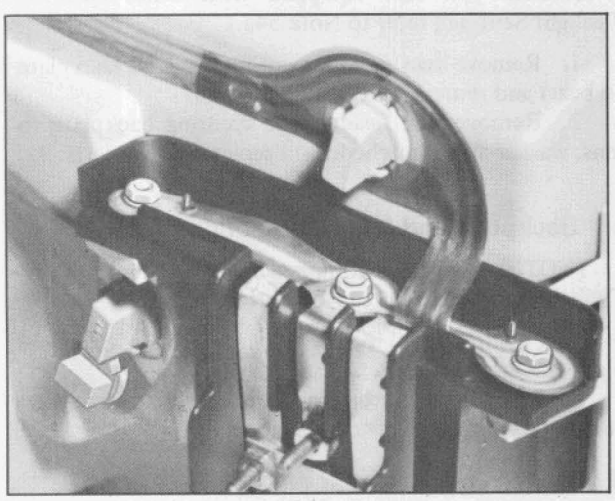


Fig. 12-29 Fuel Gage

2. Install anti-rattle washer and spring-loaded control ring (Guide-Matic or Twilight Sentinel only).

3. Install backplate and lens to bezel securing with two screws at the top.

(NOTE: On cars equipped with both options, install Twilight Sentinel Control lever on dual control switch outer shaft and spring washer, spacer, and Guide-Matic spring-loaded control ring on inner shaft.)

4. Install headlight control switch assembly as described in Note 53b.

55. Fuel Gage (Fig. 12-29)

a. Removal

1. Remove instrument panel top cover as described in Note 40a.

2. Remove three screws on top of fuel gage and position printed circuit flap out of way.

3. Push wiring harness back and lift gage straight up, tipping top toward rear of car and remove fuel gage.

b. Installation

1. Push wiring back and install fuel gage into top of cluster case.

2. Position printed circuit flap on top of gage and install three screws on top of gage.

(NOTE: The printed circuit flap must be over the metal fuel gage conductor strips, otherwise the gage will not operate.)

4. Install instrument panel top cover as described in Note 40b.

56. Ignition Switch (Fig. 12-22)

a. Removal

1. Disconnect negative battery cable.

2. Position lock cylinder in "lock position.

3. Remove steering column lower cover as described in Note 41a.

4. Loosen two screws on upper steering column support and allow column to drop as far as possible without removing the screws.

CAUTION: Do not remove screws, as column may bend under its own weight.

5. Disconnect ignition switch connector at switch.

6. Remove two screws securing ignition switch to steering column and remove switch.

b. Installation

1. Assemble ignition switch on actuator rod and adjust to "lock" position.

(NOTE: Use the following alignment procedure according to type of steering column.)

Standard Steering Column:

The lock position can be found by holding the switch actuating rod stationary with one hand, then moving the switch toward the bottom of the column with the other hand until the end of travel in the switch

has been reached. This is the accessory position. Next, back off one detent in the switch and this will be the lock position. Make sure the ignition key is in the lock position, then assemble the ignition switch to the column using the two screws provided. Take care to assure proper engagement of drive rod and switch slider without moving from "lock" position. Tighten screws to 35 inch-pounds.

Tilt and Telescope Column:

The lock position can be found by holding the actuator rod stationary with one hand, then moving the switch toward the upper end of the column with the other hand until the end of travel in the switch has been reached. This is the accessory position. Next back off one detent in the switch and this will be the lock position. Make sure the ignition key is in the "lock" position, then assemble the ignition switch to the column using the two screws provided. Tighten screws to 35 inch-pounds.

2. Connect ignition switch connector at switch.
3. Tighten two screws on upper steering column.
4. Install steering column lower cover as described in Note 41b.
5. Connect negative battery cable.

57. Radio Receiver Unit

a. Removal

1. Remove steering column lower cover as described in Note 41a.
2. Remove radio knobs, wave washers or coil springs and control rings.
3. Remove hex nuts securing control shafts to instrument panel.
4. Disconnect power connector, antenna lead-in cable, and speaker connectors.
5. Remove two hex head screws securing lower support bracket to radio and instrument panel center support and remove bracket.
6. Pull receiver unit back from instrument panel to disengage control shafts and lower receiver out of panel to gain access to dial bulb.
7. Disconnect dial bulb socket from radio and remove radio receiver unit.

b. Installation

1. Install dial bulb socket into receiver unit and position unit in instrument panel.
2. Support receiver unit and secure control shafts with hex nuts.
3. Install lower support bracket and secure with two hex head screws, one to receiver unit and one to instrument panel center support, making sure the shorter screw is used for the support bracket at radio.
4. Connect power connector, lead-in cable, and speaker connector.

(NOTE: Turn on radio, test for operation, trim antenna as described in Section 15, Note 4a.)

5. Install control rings, wave washers or coil springs and radio knobs by pressing on.
6. Install steering column lower cover as described in Note 41b.

(NOTE: Radio should not be turned on without all speakers connected.)

58. Radio Front Speaker

a. Removal

1. Remove instrument panel top cover as described in Note 40a.
2. Remove four speed nuts securing speaker to grille and remove front speaker, Fig. 12-30.

b. Installation

1. Position front speaker on instrument panel top cover and grille. Secure with four speed nuts, Fig. 12-30.
2. Install instrument panel top cover as described in Note 40b.

59. Radio Front Speaker Grille (Fig. 12-30)

a. Removal

1. Remove instrument panel top cover as described in Note 40a.
2. Remove front speaker as described in Note 58a.
3. Remove screws securing grille to top cover and remove grille.

b. Installation

1. Install grille on top cover and secure with screws.
2. Install front speaker as described in Note 58b.
3. Install instrument panel top cover as described in Note 40b.

60. Cigar Lighter Base Assembly

a. Removal

1. Open ashtray door and remove cigar lighter and ash tray receptacle.
2. Remove two screws securing ash tray door cover to ash tray housing and remove door cover.
3. Disconnect ash tray housing bulb socket from shield and cigar lighter base feed wire from cigar lighter base.
4. Remove lighter base from sleeve by holding sleeve and rotating lighter base.
5. Remove lighter base from ash tray housing.

b. Installation

1. Position lighter base in ash tray housing.
2. Hold lighter sleeve in position and screw base into sleeve. Bulb shield must face up when tight to allow light to enter ash tray receptacle.
3. Connect ash tray housing bulb socket to shield and feed wire to cigar lighter base.
4. Position ash tray door cover on ash tray housing and secure with two attaching screws.
5. Install ash tray receptacle and cigar lighter into ash tray housing. Close ash tray door.

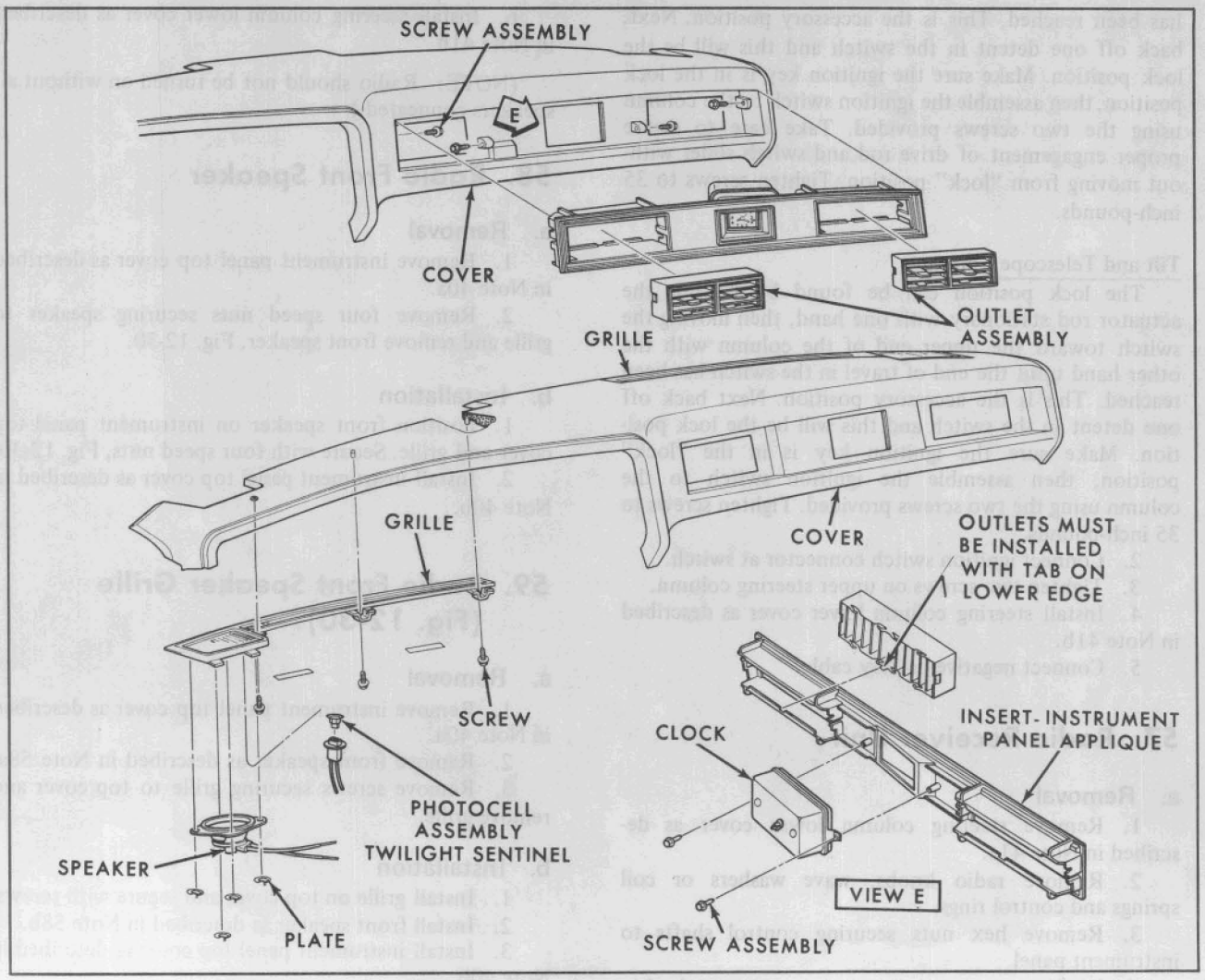


Fig. 12-30 Instrument Panel Top Cover

61. Ash Tray Assembly

a. Removal

1. Remove steering column lower cover as described in Note 41a.

2. Remove three screws and two washers securing ash tray assembly to lower cover and remove assembly.

b. Installation

1. Position ash tray assembly on lower cover and secure with three screws and two washers.

2. Install steering column lower cover as described in Note 41b.

62. Ventilation Control Cable and Knob Assembly

a. Removal

1. Remove two screws that secure knob to underside of lower instrument panel.

2. Pull cowl kick pad away from cowl.

3. Remove clip washer that holds bowden cable on control lever pins.

4. Remove bowden cable clamp screw and disconnect cable from control lever pin and cable clamp.

b. Installation

1. Install bowden cables on control lever pin and secure with clip washer.

2. Install bowden cable in cable clamp and tighten screw that holds cable clamp.

3. Reposition cowl kick pad.

4. Install two screws that secure knob to underside of lower instrument panel.

63. Heater Control Panel Assembly

a. Removal

1. Remove steering column lower cover as described in Note 41a.

2. Remove vacuum valve connector from bottom of heater control panel assembly.

3. Remove two-way switch connector from bottom of assembly.

4. Remove two screws that secure assembly to lower instrument panel.

5. Pull assembly toward cowl and disconnect dial bulb socket and four-way switch connector from top of assembly.

6. Remove assembly from beneath lower instrument panel cover.

b. Installation

1. Position heater control panel assembly and connect dial bulb socket and one four-way switch connector at top.

2. Install assembly on lower instrument panel. Secure with two screws.

3. Connect two-way switch connector at bottom of assembly.

4. Install vacuum valve connector at bottom of assembly.

5. Install steering column lower cover as described in Note 41b.

64. Automatic Climate Control Panel Assembly

a. Removal

1. Remove steering column lower cover as described in Note 41a.

2. Remove vacuum valve connector from bottom of control panel assembly.

3. Disconnect wiring connector and bulb socket from control panel.

4. Working behind instrument panel, remove two screws securing control panel to bezel assembly and one screw from brace at back of control panel.

5. Remove control panel assembly from beneath instrument panel.

b. Installation

1. Install control panel in bezel and secure with two screws, and one screw in brace.

CAUTION: If screws are not installed straight threads in bezel bosses may be stripped.

2. Connect wiring connector and bulb socket to control panel.

3. Connect vacuum valve connector at bottom of control panel assembly.

4. Install steering column lower cover as described in Note 41b.

65. Climate Control Sensor (In Car)

a. Removal

1. Remove instrument panel top cover as described in Note 40a.

2. Remove two screws securing sensor to top cover and remove sensor.

b. Installation

1. Position sensor to top cover and secure with two screws.

2. Install instrument panel top cover as described in Note 40b.

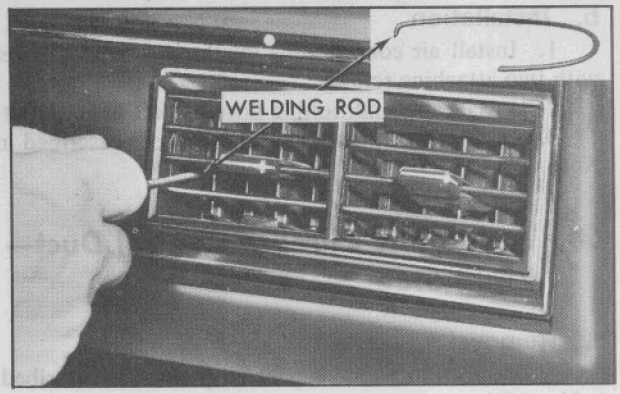


Fig. 12-31 Removing Automatic Climate Control Air Outlet Grille

66. Automatic Climate Control Air Outlet Grilles (Fig. 12-31)

a. Removal

(NOTE: Grille vanes must be horizontally and vertically positioned before removing.)

1. Using a welding rod, with a hook formed at one end, reach in on right and left side of grille and gently pull, working grille out of its socket.

b. Installation

(NOTE: Tab on back side of grille is placed at top or bottom depending on which grille was removed. Check opening for correct position, Fig. 12-32.)

1. Install grille in opening and press into place.

67. Automatic Climate Control Duct—Left Side

a. Removal

1. Remove instrument panel top cover as described in Note 40a.

2. Disconnect air conditioning hose from left hand outlet.

3. Remove two screws securing duct to bezel assembly and remove duct.

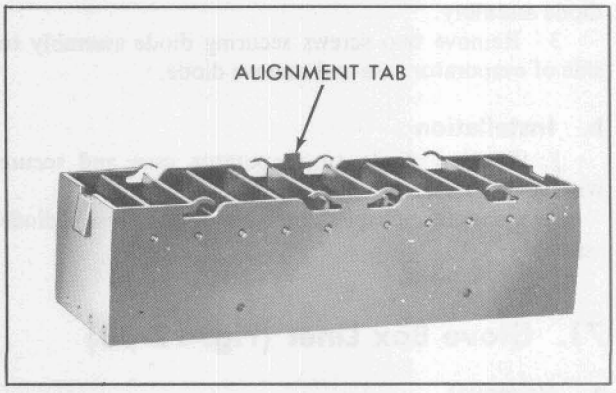


Fig. 12-32 Installing Automatic Climate Control Air Outlet Grille

b. Installation

1. Install air conditioning duct and secure to bezel with two attaching screws.
2. Install air conditioning hose on left hand outlet.
3. Install instrument panel top cover as described in Note 40b.

68. Automatic Climate Control Duct—Right Side

a. Removal

1. Remove instrument panel top cover as described in Note 40a.
2. Remove air conditioner hose from right side duct.
3. Depress tab at top center of duct and pull duct up and remove duct.

b. Installation

1. Slide duct into place until secured by tab.
2. Install air conditioner hose on right side duct.
3. Install instrument panel top cover as described in Note 40b.

69. Automatic Climate Control Boot Center Air Outlet

a. Removal

1. Remove instrument panel top cover as described in Note 40a.
2. Slide boot off center duct and remove boot.

b. Installation

1. Insert center air outlet boot onto center duct.
2. Install instrument panel top cover as described in Note 40b.

70. Compressor Diode Assembly (697 Styles Only)

a. Removal

1. Open hood.
2. Disconnect multiple connector at compressor diode assembly.
3. Remove two screws securing diode assembly to side of evaporator case and remove diode.

b. Installation

1. Position diode to evaporator case and secure with two screws.
2. Connect multiple connector at compressor diode assembly.
3. Close hood.

71. Glove Box Liner (Fig. 12-33)

a. Removal

1. Open glove box door and remove five screws that secure glove box liner to glove box housing.

CAUTION: Do not apply excessive downward pressure to the door at this point, as it may break the hinges.

2. Carefully remove glove box liner through door opening.

b. Installation

1. Position glove box liner into housing through door opening.
2. Align glove box liner to housing and secure with four attaching screws, leaving the upper right-hand screw out.
3. Position right-hand door stop cable to liner at upper right-hand position and secure with remaining screw.

72. Glove Box Door (Fig. 12-33)

a. Removal

1. Working under instrument panel cover remove four screws, two each hinge.
2. Open glove box door and remove two screws, one at each door stop.
3. Remove door stop cables and remove door.

b. Installation

1. Position glove box and loosely install four screws, two each hinge.
2. Install door stop cables and secure with two screws.
3. Align glove box door and tighten screws at hinges.

73. Glove Box Lock (Fig. 12-33)

a. Removal

1. With door open, set fork bolt in closed position.
2. With key out, depress retainer through access hole on top of lock casing.
3. While retainer is depressed, insert key into lock and remove lock cylinder.
4. Remove escutcheon.
5. Remove washer, filler, and lock cylinder casing.

b. Installation

1. Install washer, filler and lock cylinder casing into glove box door and secure with escutcheon.
2. Insert key into lock cylinder.
3. While holding the fork bolt in the closed position, depress retainer through access hole in top of lock casing and install lock cylinder.

74. Glove Box Latch Assembly (Fig. 12-33)

a. Removal

1. Remove instrument panel top cover as described in Note 40a.
2. Loosen two screws on clamp securing striker and remove striker through top of glove box.

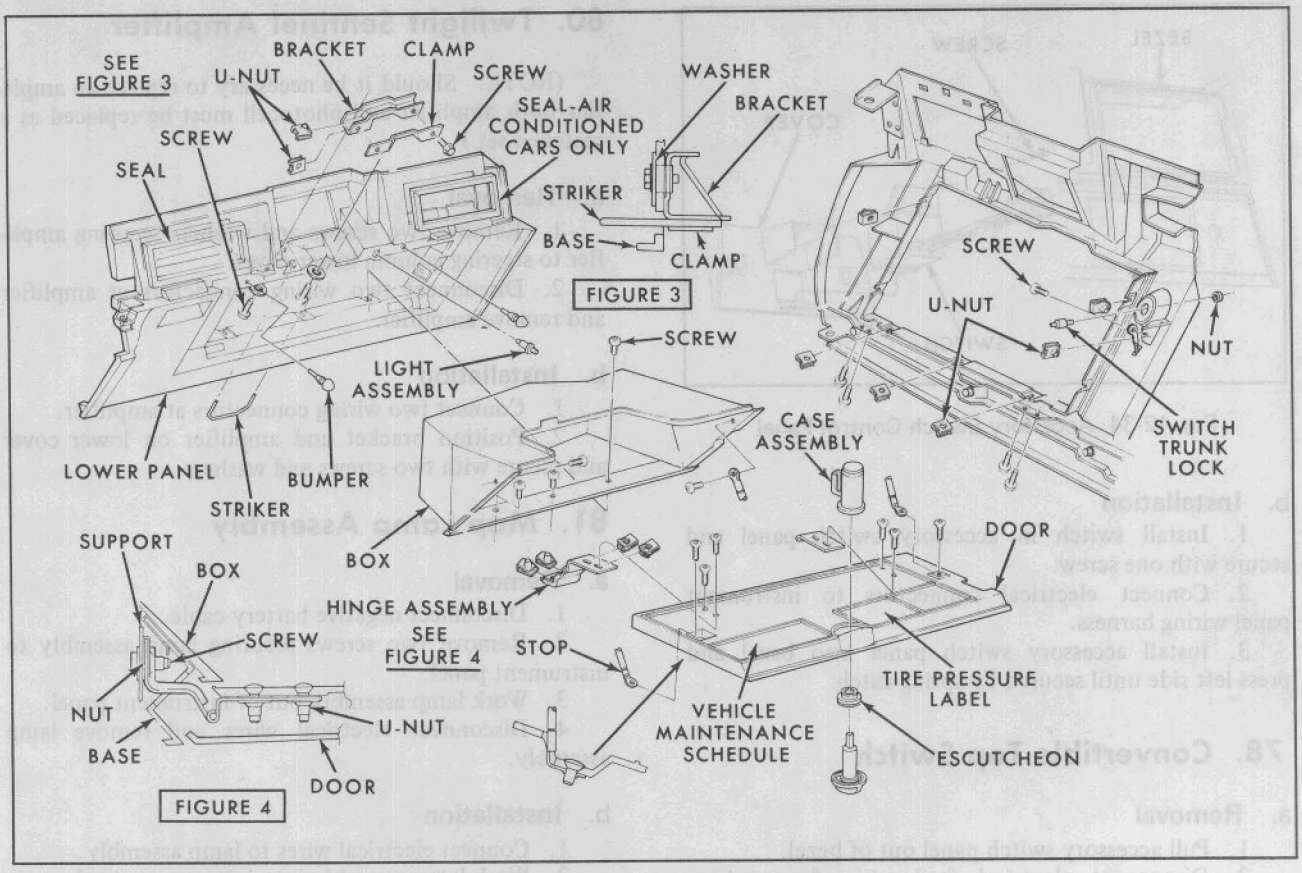


Fig. 12-33 Glove Box Disassembled

3. Remove two screws from inside of glove box securing bracket and remove assembly.

b. Installation

1. Install bracket assembly and secure with two screws.
2. Install striker and snugly secure with screws on clamp.
3. Adjust striker and tighten clamp screws.
4. Install instrument panel top cover as described in Note 40b.

75. Cruise Control On-Off Switch

a. Removal

1. Remove steering column lower cover as described in Note 41a.
2. Disconnect two wiring connectors in harness attached to switch.
3. Remove two screws securing switch to bezel and remove switch.

b. Installation

1. Install switch into bezel and secure with two screws.
2. Connect two wiring connectors in harness attached to switch.
3. Install steering column lower cover as described in Note 41b.

76. Twilight Sentinel Photocell

(NOTE: Should it be necessary to replace the photocell, both photocell and amplifier must be replaced as a matched set.)

a. Removal

1. Remove instrument panel top cover as described in Note 40a.
2. Rotate plastic photocell holder counterclockwise to remove from underside of instrument panel top cover.
3. Remove photocell from plastic holder.

b. Installation

1. Insert photocell into plastic holder.
2. Install plastic holder into underside of instrument panel top cover by rotating clockwise.
3. Install instrument panel top cover as described in Note 40b.

77. Rear Window De-Fogger Switch

a. Removal

1. Pull accessory switch panel out of bezel.
2. Disconnect electrical feed wires from wiring harness.
3. Remove one screw and remove switch.

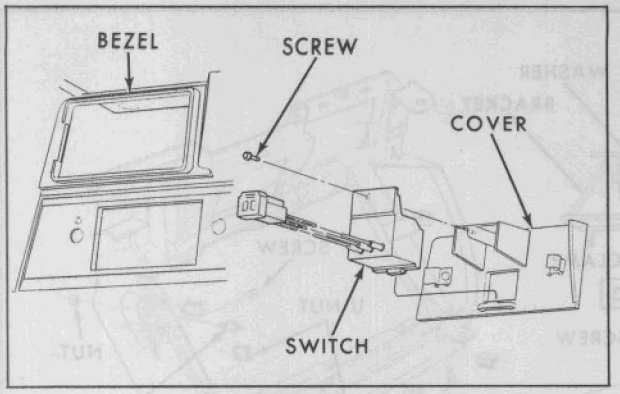


Fig. 12-34 Accessory Switch Control Panel

b. Installation

1. Install switch in accessory switch panel and secure with one screw.
2. Connect electrical connectors to instrument panel wiring harness.
3. Install accessory switch panel into bezel and press left side until secured by spring catch.

78. Convertible Top Switch

a. Removal

1. Pull accessory switch panel out of bezel.
2. Disconnect electrical feed wires from wiring harness.
3. Remove one screw and remove switch.

b. Installation

1. Install switch in accessory switch panel and secure with one screw.
2. Connect electrical connectors to instrument panel wiring harness.
3. Install accessory switch panel into bezel and press left side until secured by spring catch.

79. Sunroof Switch

a. Removal

1. Pull accessory switch panel out of bezel.
2. Disconnect electrical feed wires from wiring harness.
3. Remove one screw and remove switch.

b. Installation

1. Install switch in accessory switch panel and secure with one screw.
2. Connect electrical connectors to instrument panel wiring harness.
3. Install accessory switch panel into bezel and press left side until secured by spring catch.

80. Twilight Sentinel Amplifier

(NOTE: Should it be necessary to replace an amplifier both amplifier and photocell must be replaced as a matched set.)

a. Removal

1. Remove two screws and washers securing amplifier to steering column lower cover.
2. Disconnect two wiring connectors at amplifier and remove amplifier.

b. Installation

1. Connect two wiring connectors at amplifier.
2. Position bracket and amplifier on lower cover and secure with two screws and washers.

81. Map Lamp Assembly

a. Removal

1. Disconnect negative battery cable.
2. Remove two screws securing lamp assembly to instrument panel.
3. Work lamp assembly out of instrument panel.
4. Disconnect electrical wires and remove lamp assembly.

b. Installation

1. Connect electrical wires to lamp assembly.
2. Work lamp assembly into instrument panel.
3. Install two screws securing lamp assembly to instrument panel.
4. Connect negative battery cable.

82. Hood Lock Release

a. Removal

1. Remove clip from cable at hood lock.
2. Thread cable out thru radiator cradle.
3. Remove four screws securing left side sill plate and remove sill plate.
4. Remove screw securing left side kick panel.
5. Partially remove kick panel to gain access to lock handle.
6. Pull handle bracket from behind tab on kick panel and remove cable assembly.

b. Installation

1. Thread cable thru kick panel and fire wall.
2. Install handle assembly in kick panel so that handle is vertical and away from panel as far as possible.
3. Install handle assembly by securing under tab on kick panel.
4. Position kick panel and secure with screw.
5. Install sill plate and secure with four screws.
6. Thread cable thru inside of fender well, thru radiator cradle and secure to hood lock latch with clip.

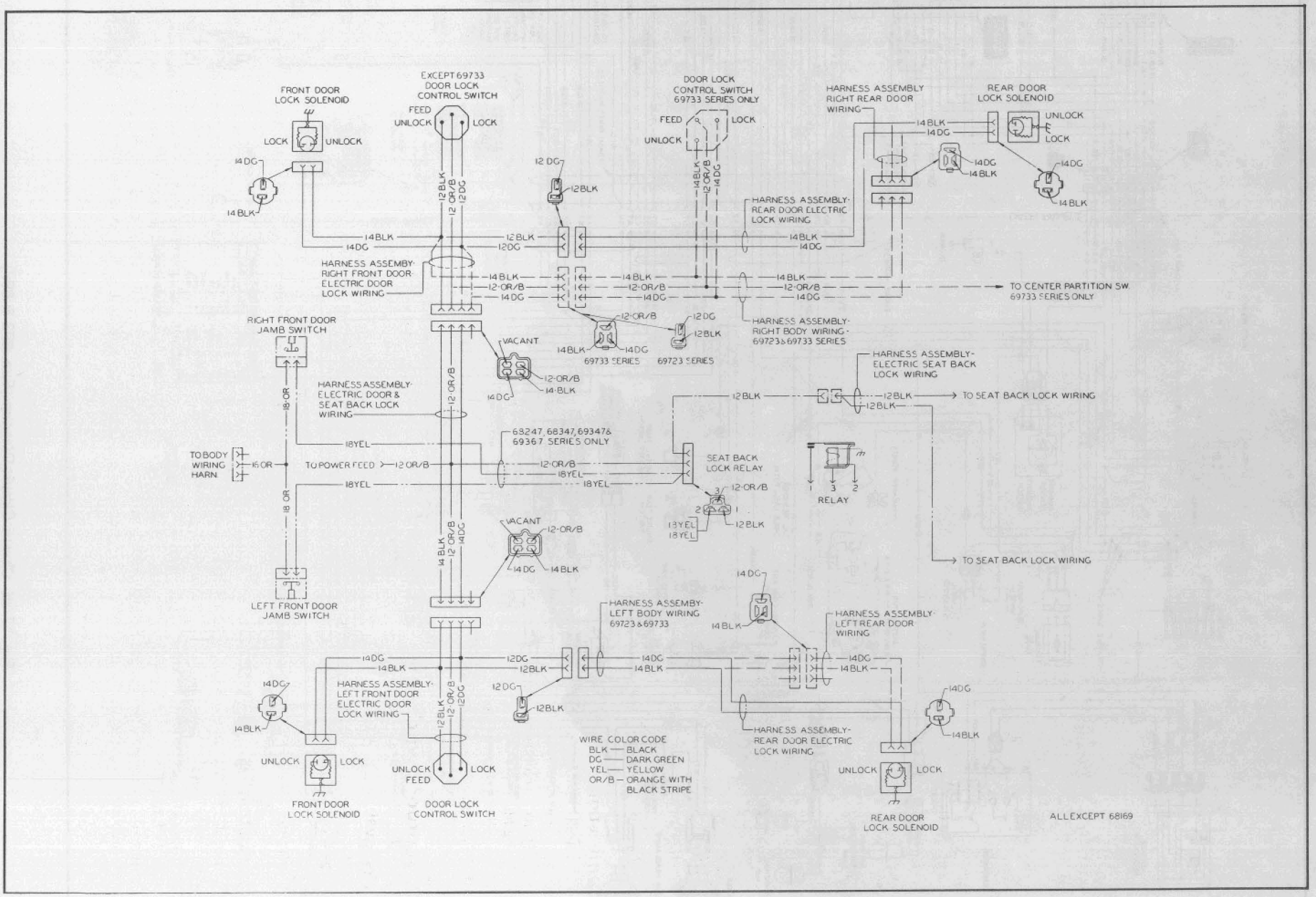


Fig. 12-35 Optional Electric Door Lock and Seat Back Lock Wiring

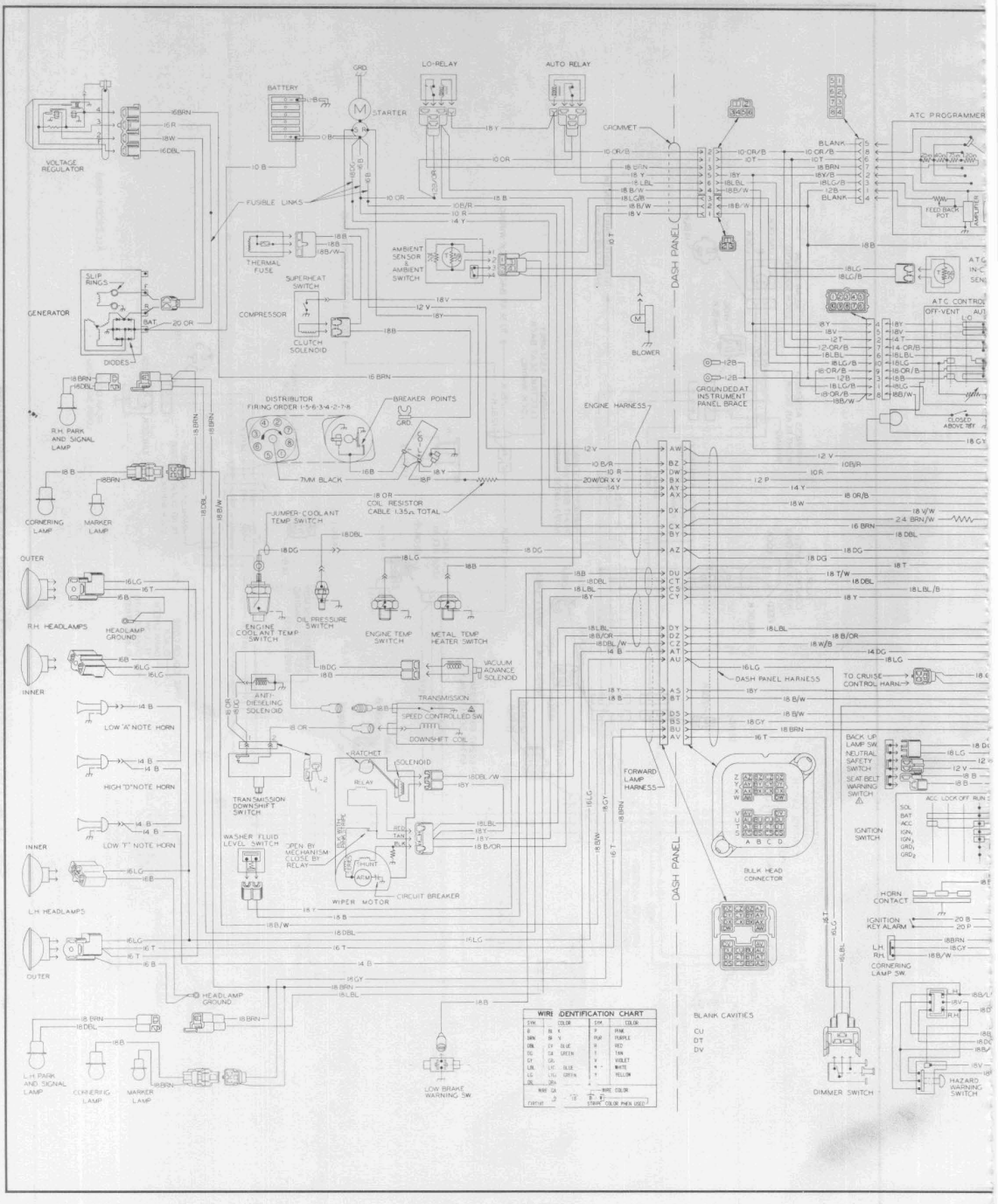


Fig. 12-36 Chassis Circuit Diagram (Exc. 693 & 697)

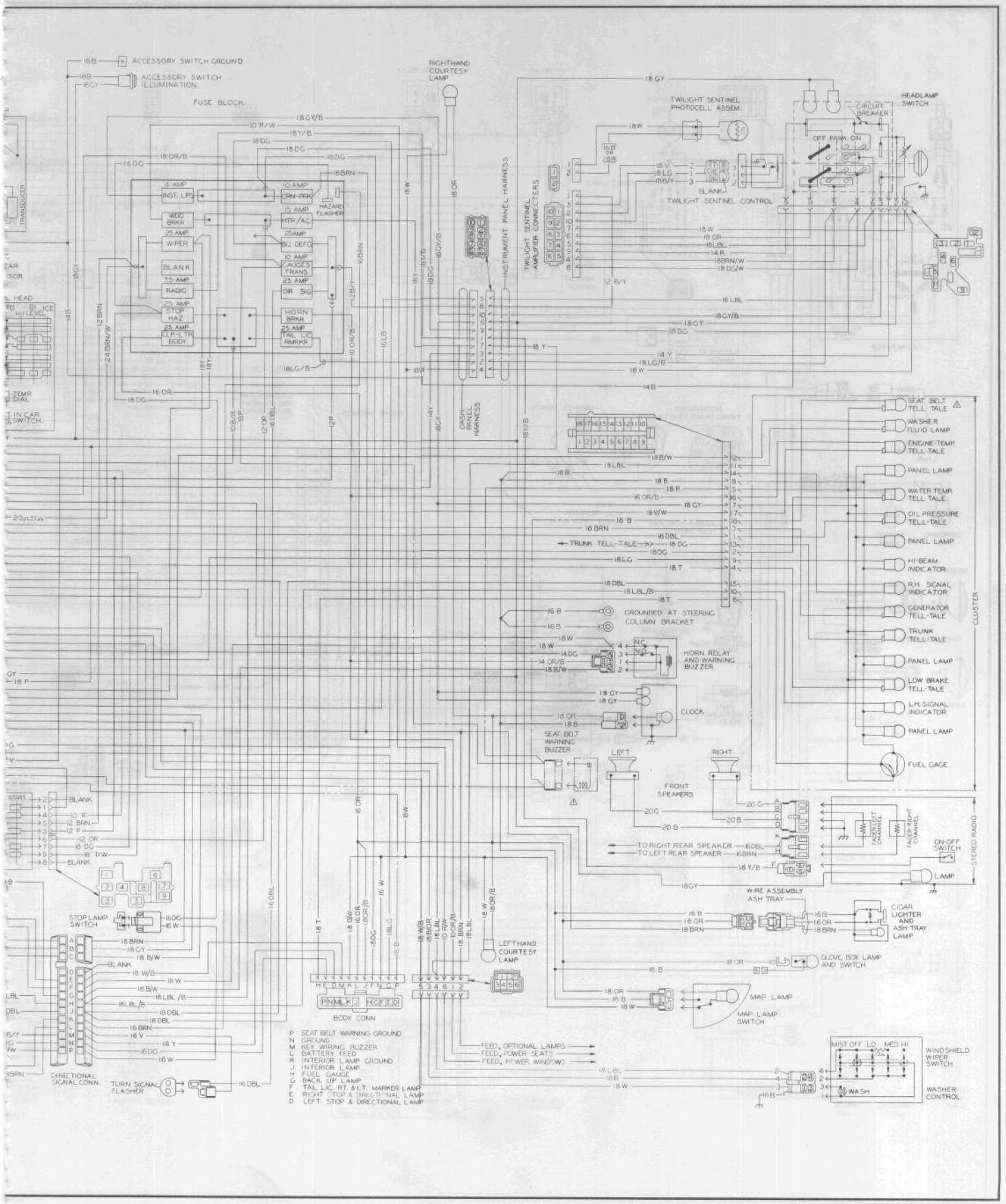


Fig. 12-36 Chassis Circuit Diagram (Exc. 693 & 697)

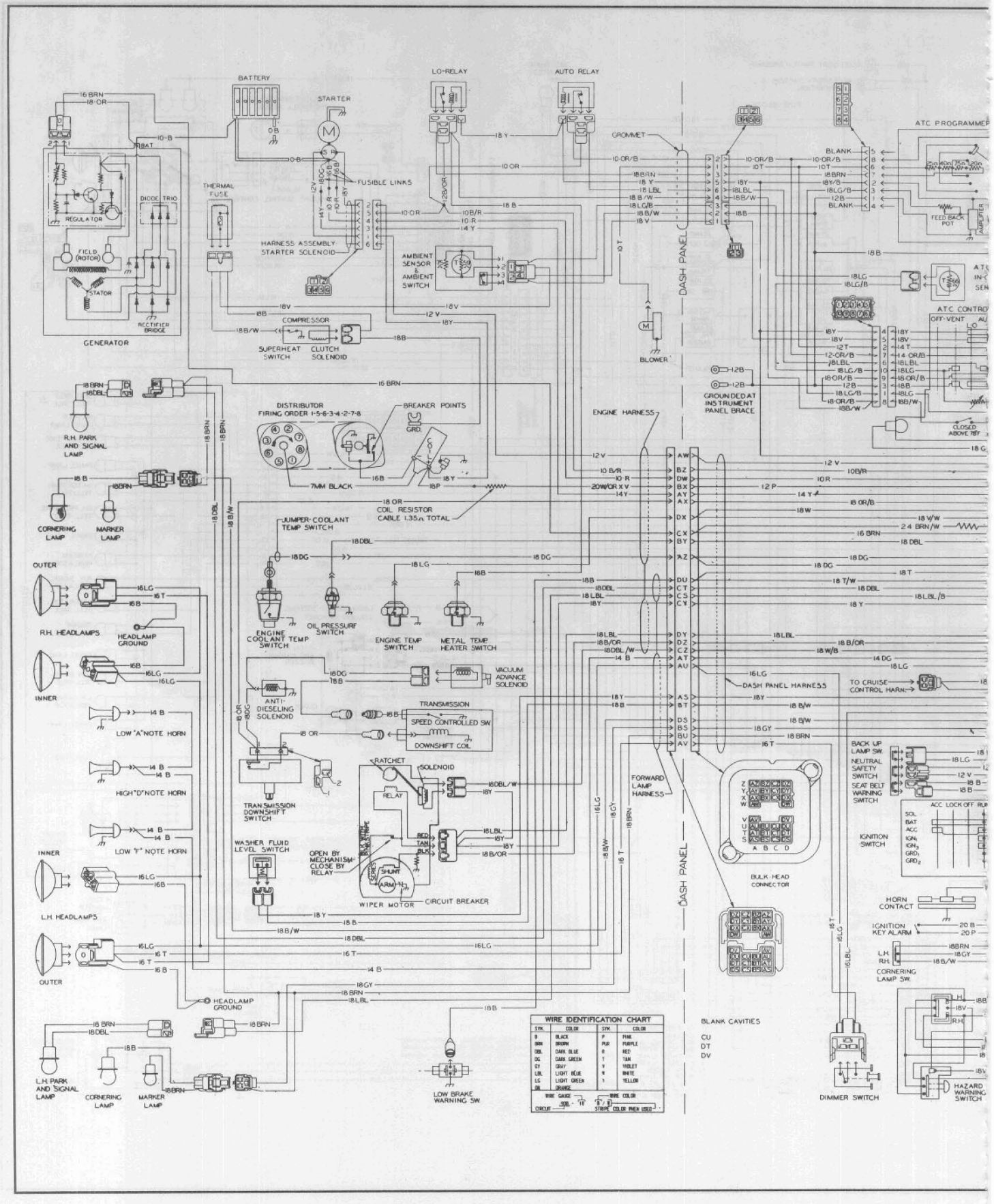


Fig. 12-37 Chassis Circuit Diagram (693)

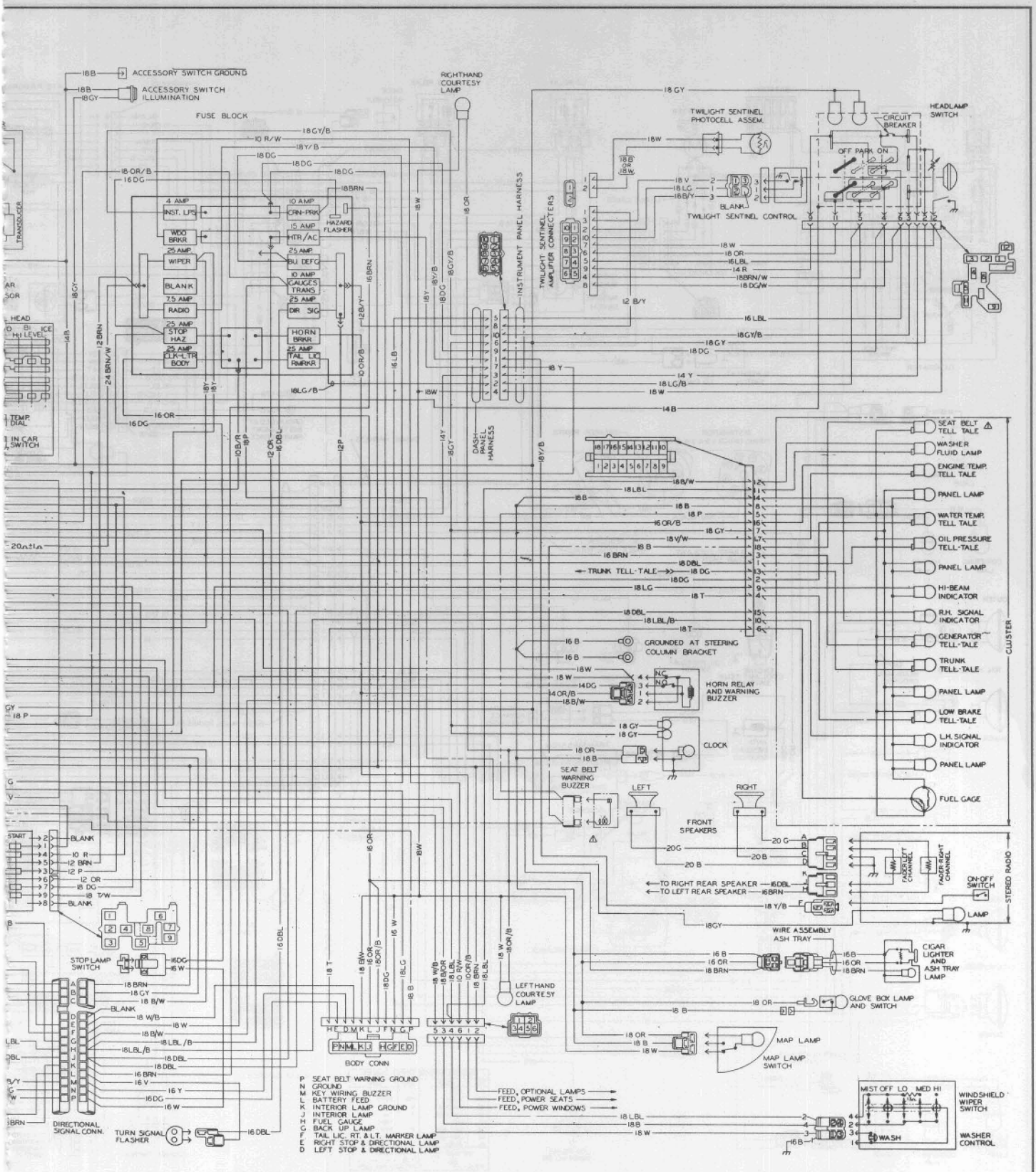


Fig. 12-37 Chassis Circuit Diagram (693)

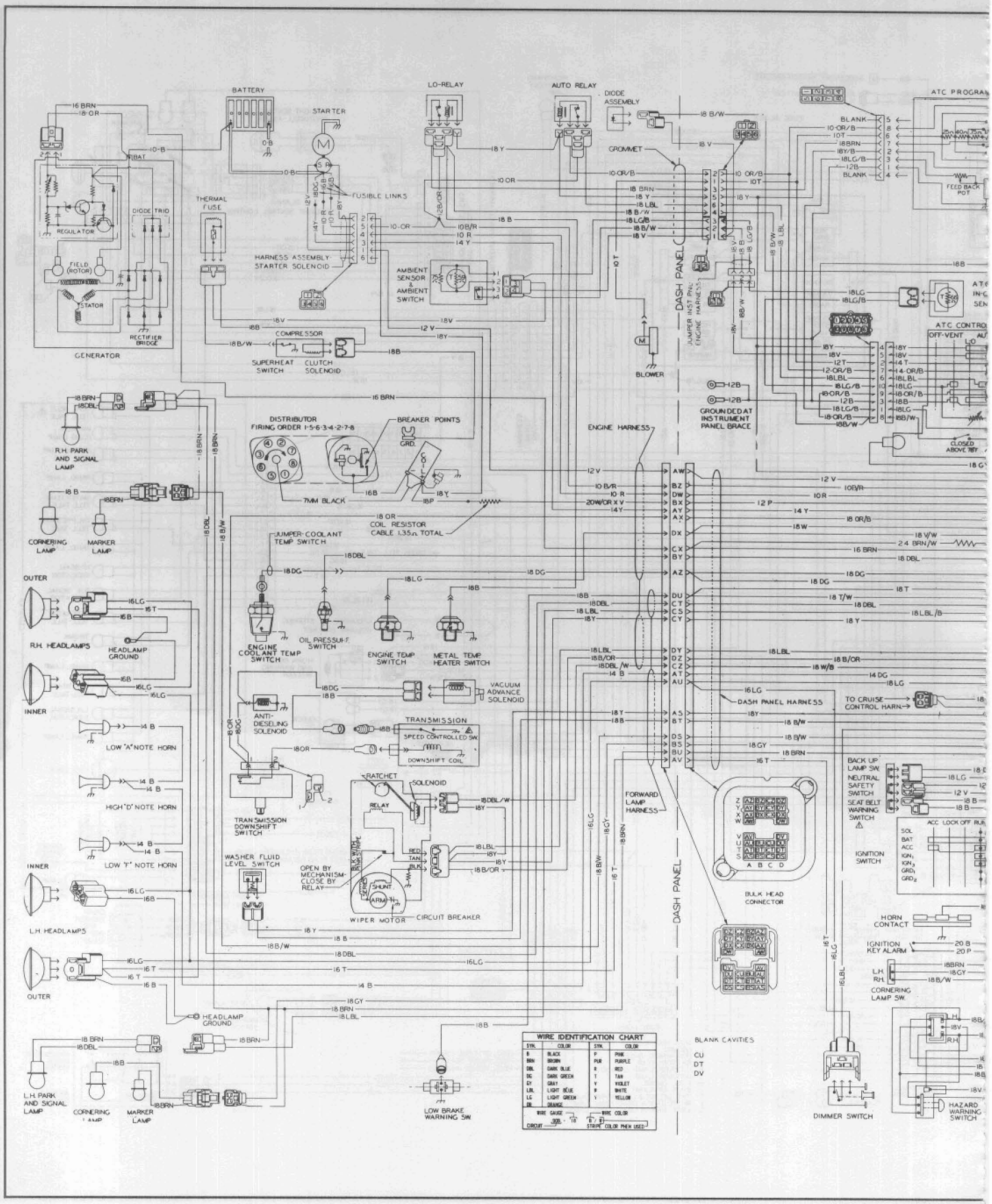


Fig. 12-38 Chassis Circuit Diagram (697)

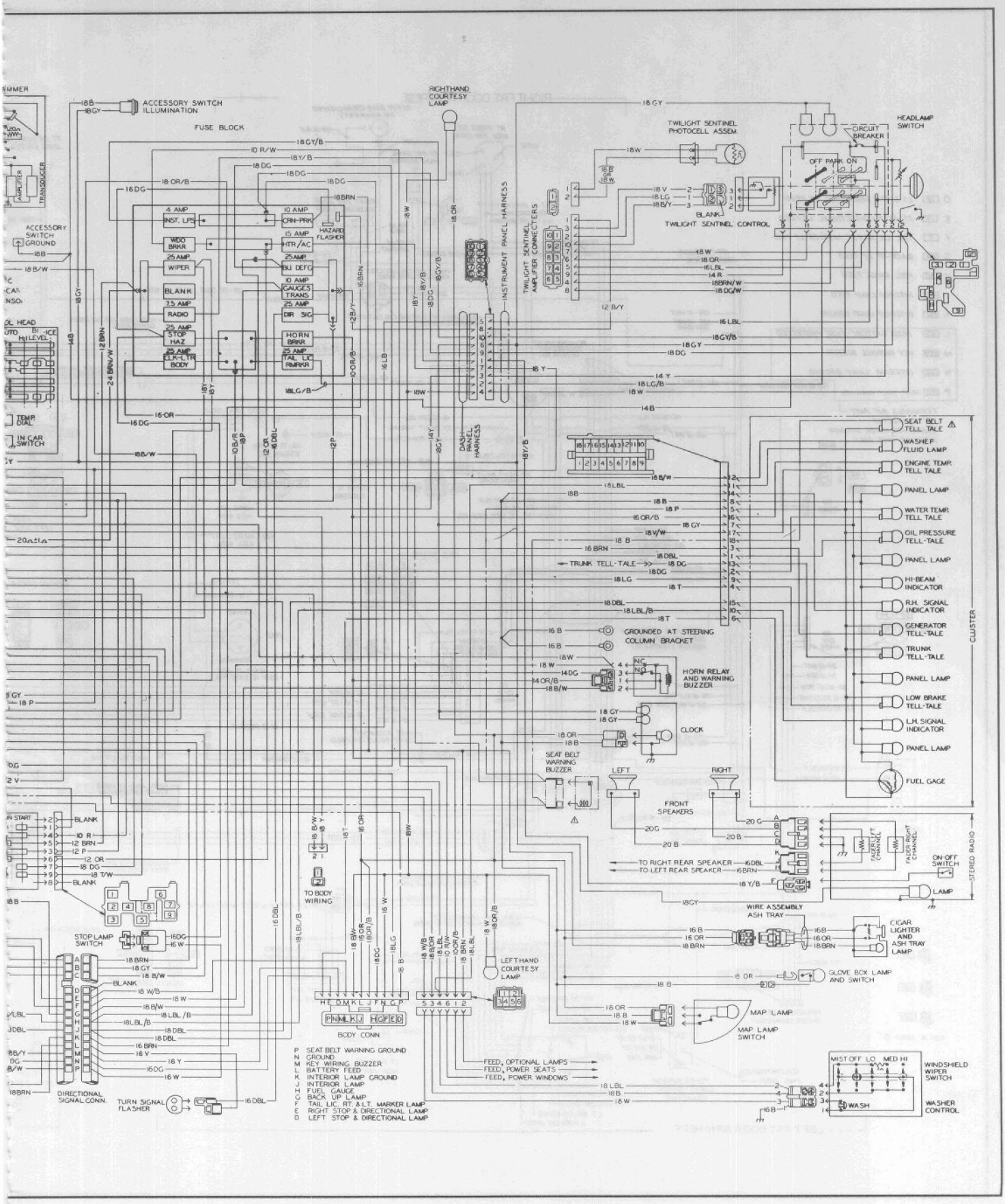


Fig. 12-38 Chassis Circuit Diagram (697)

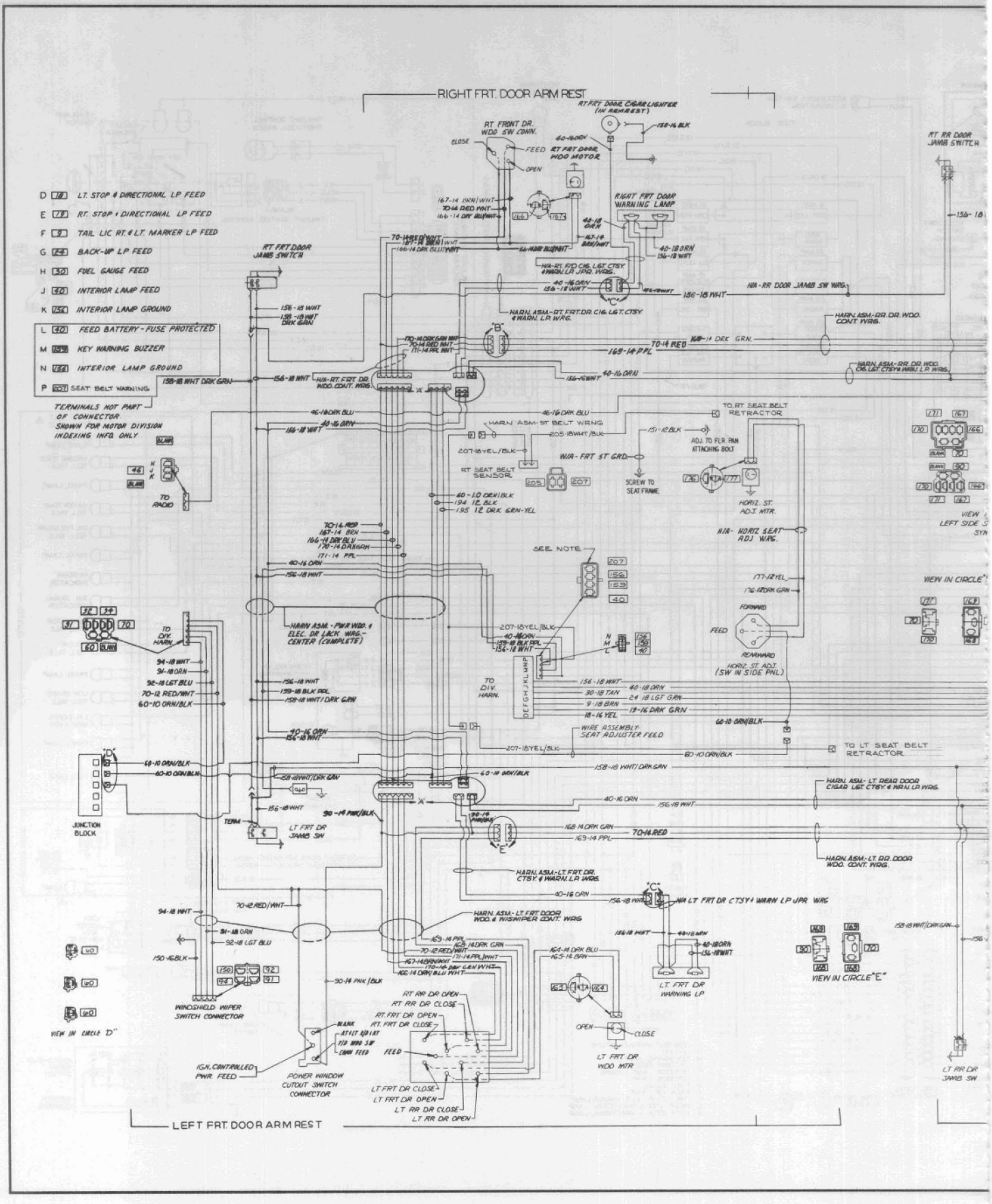


Fig. 12-39 Body Wiring Diagram (68169)

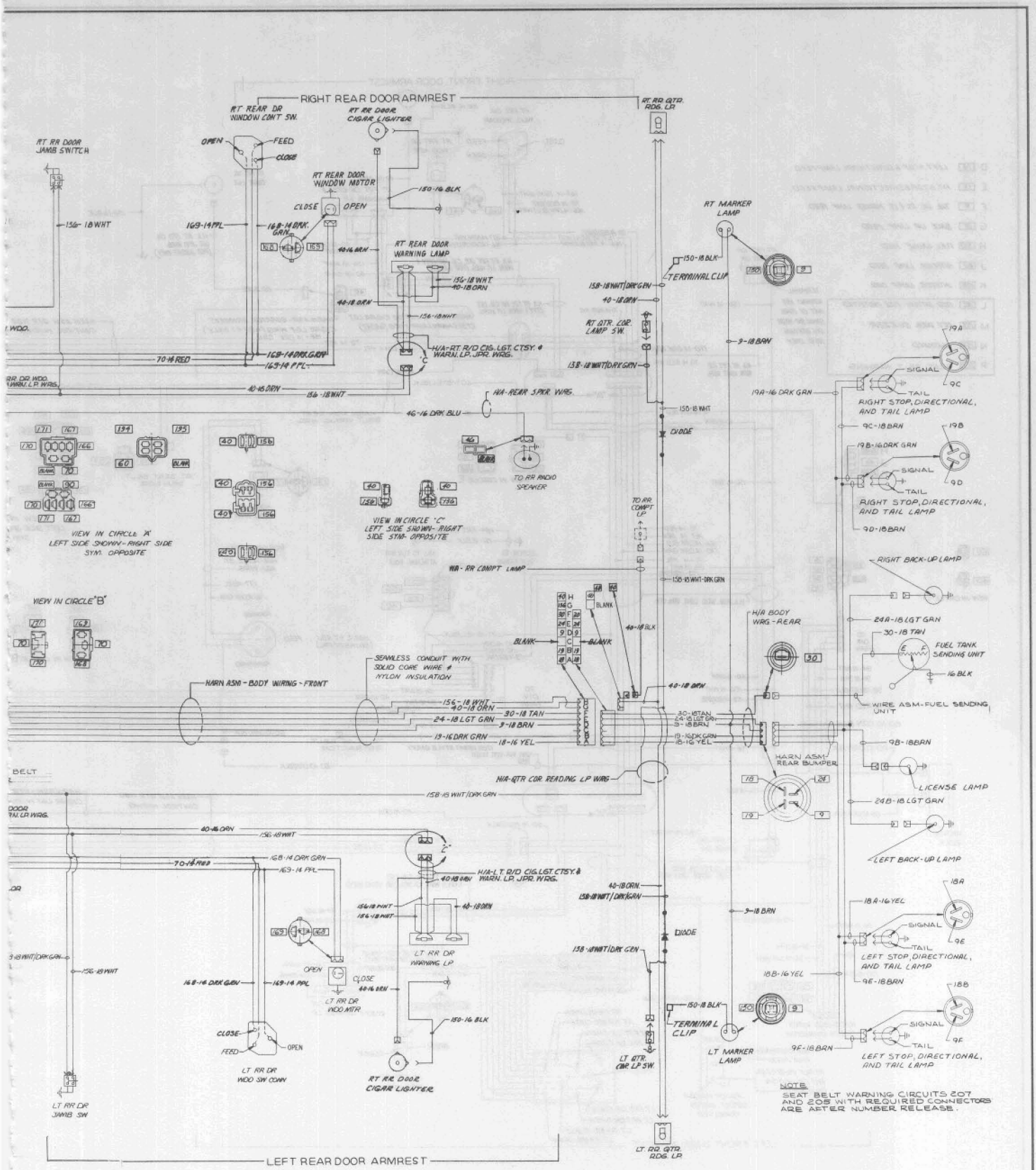


Fig. 12-39 Body Wiring Diagram (68169)

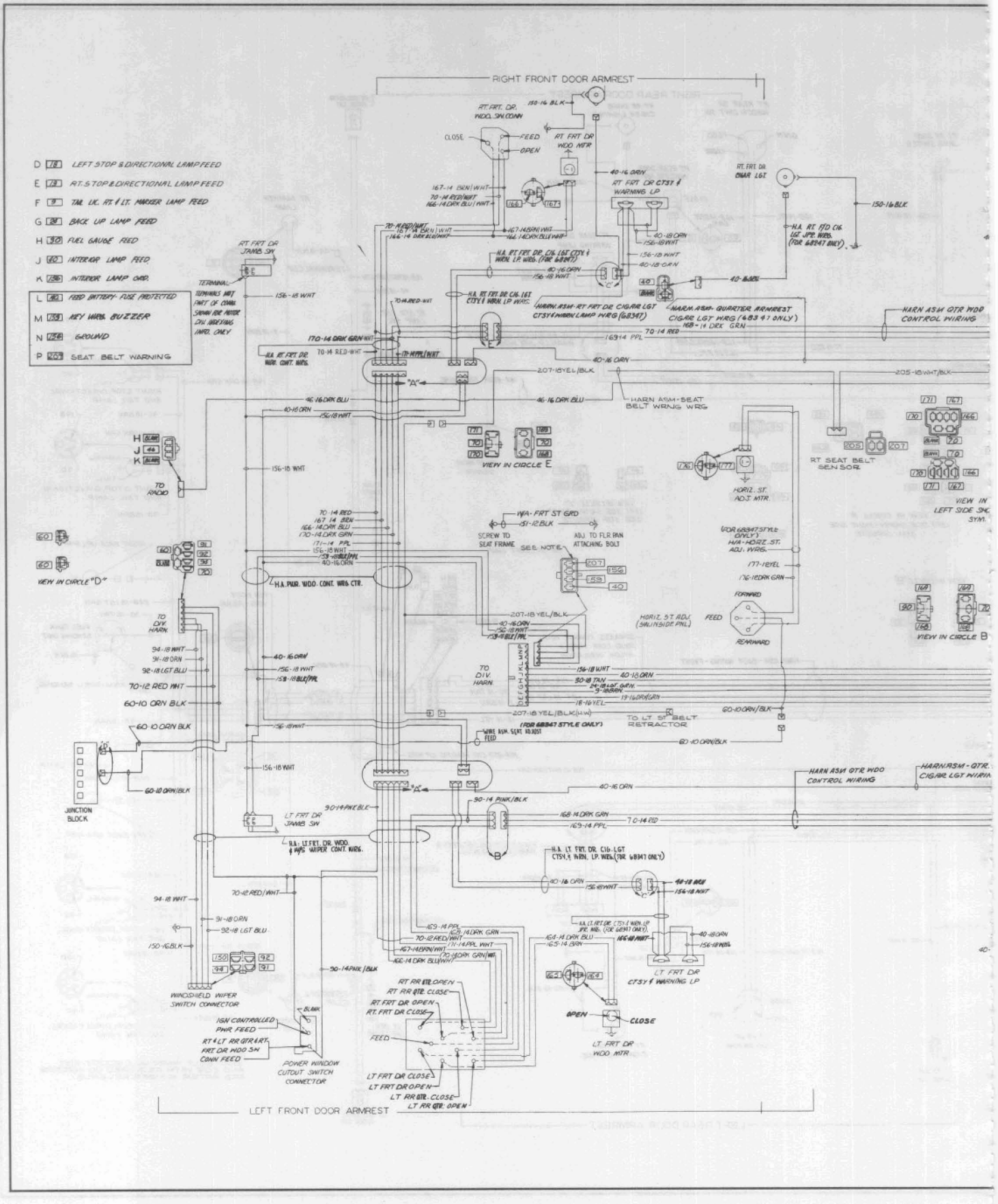


Fig. 12-40 Body Wiring Diagram (68347, 68247)

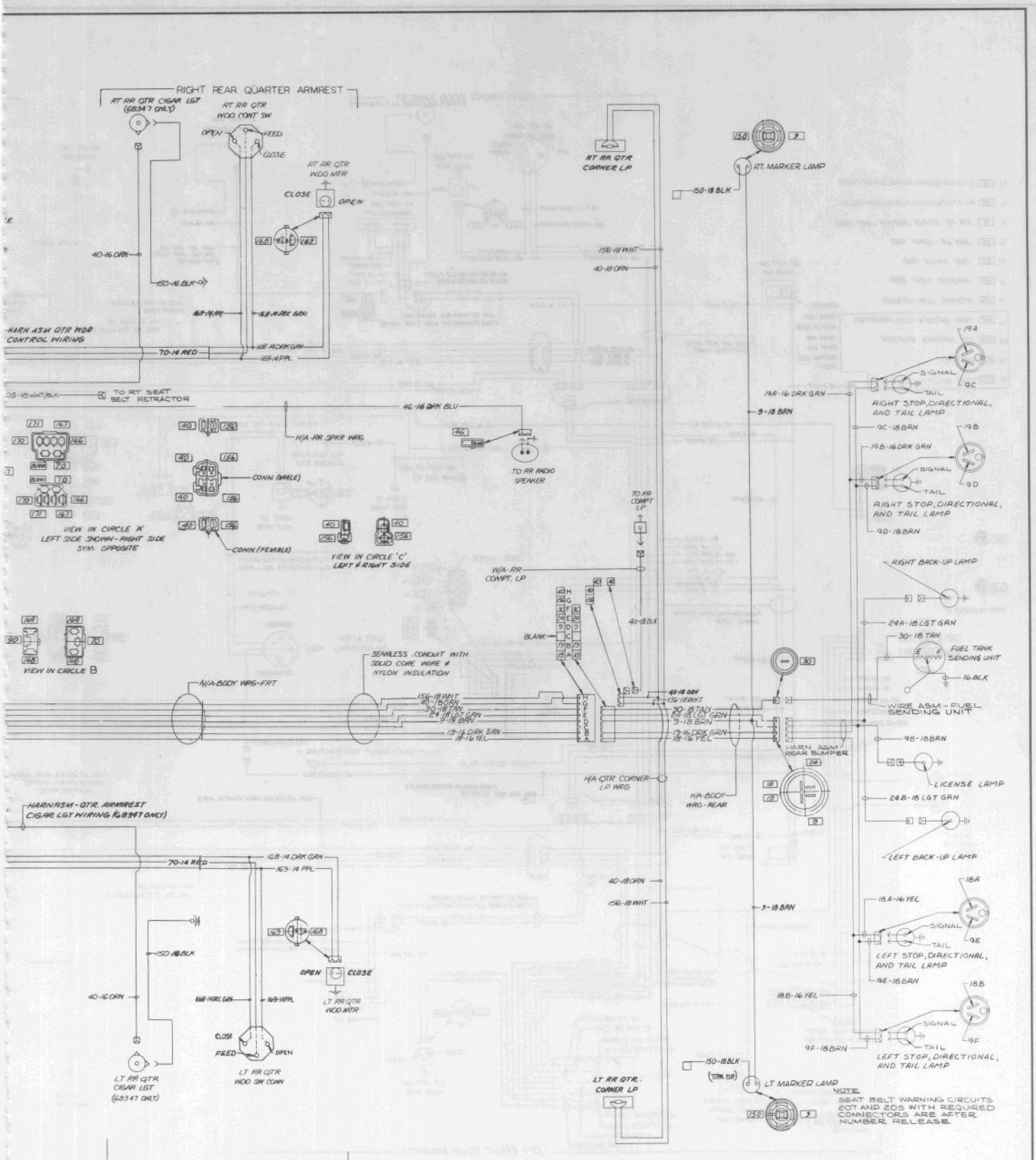


Fig. 12-40 Body Wiring Diagram (68347, 68247)

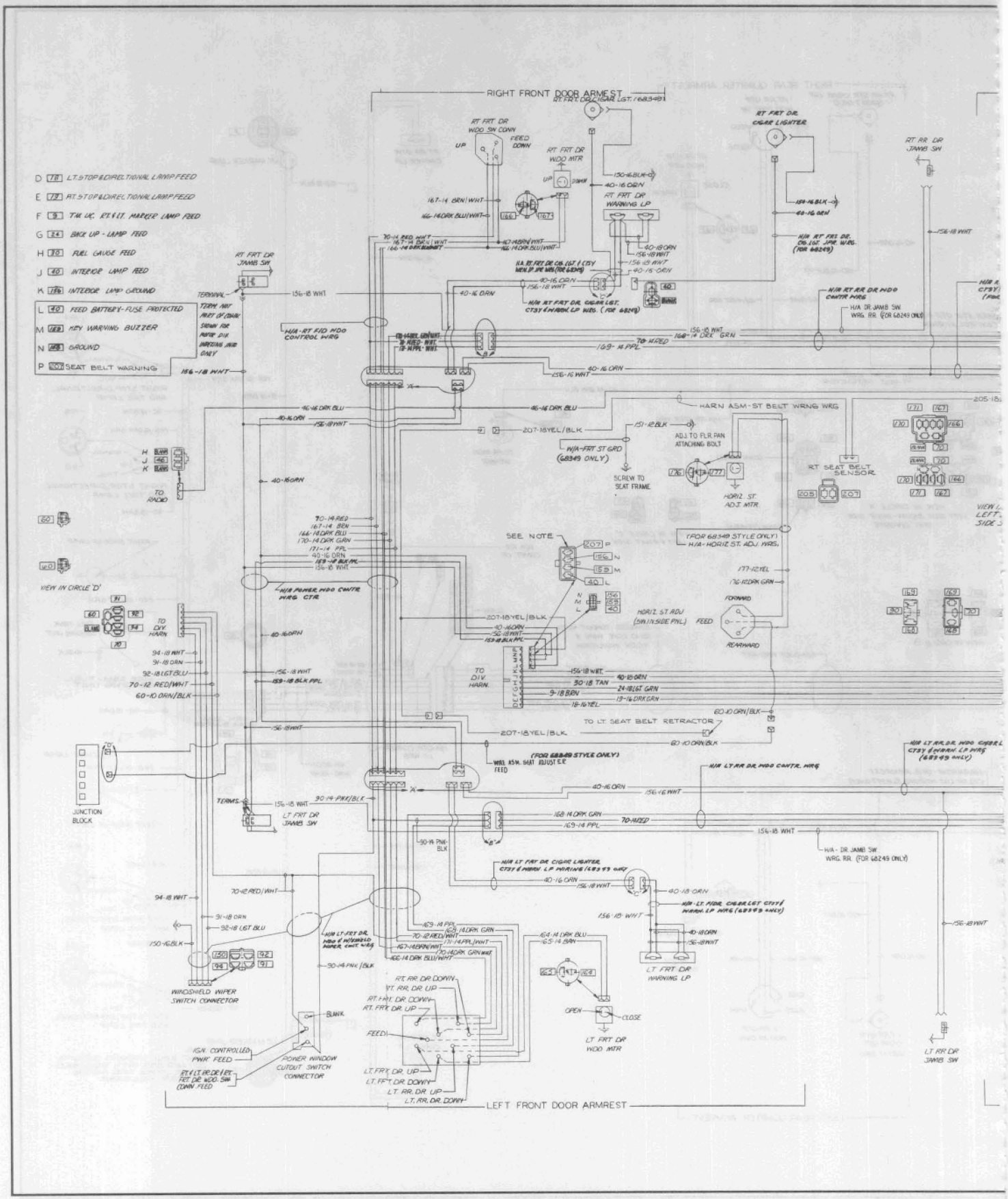


Fig. 12-41 Body Wiring Diagram (68349, 68249)

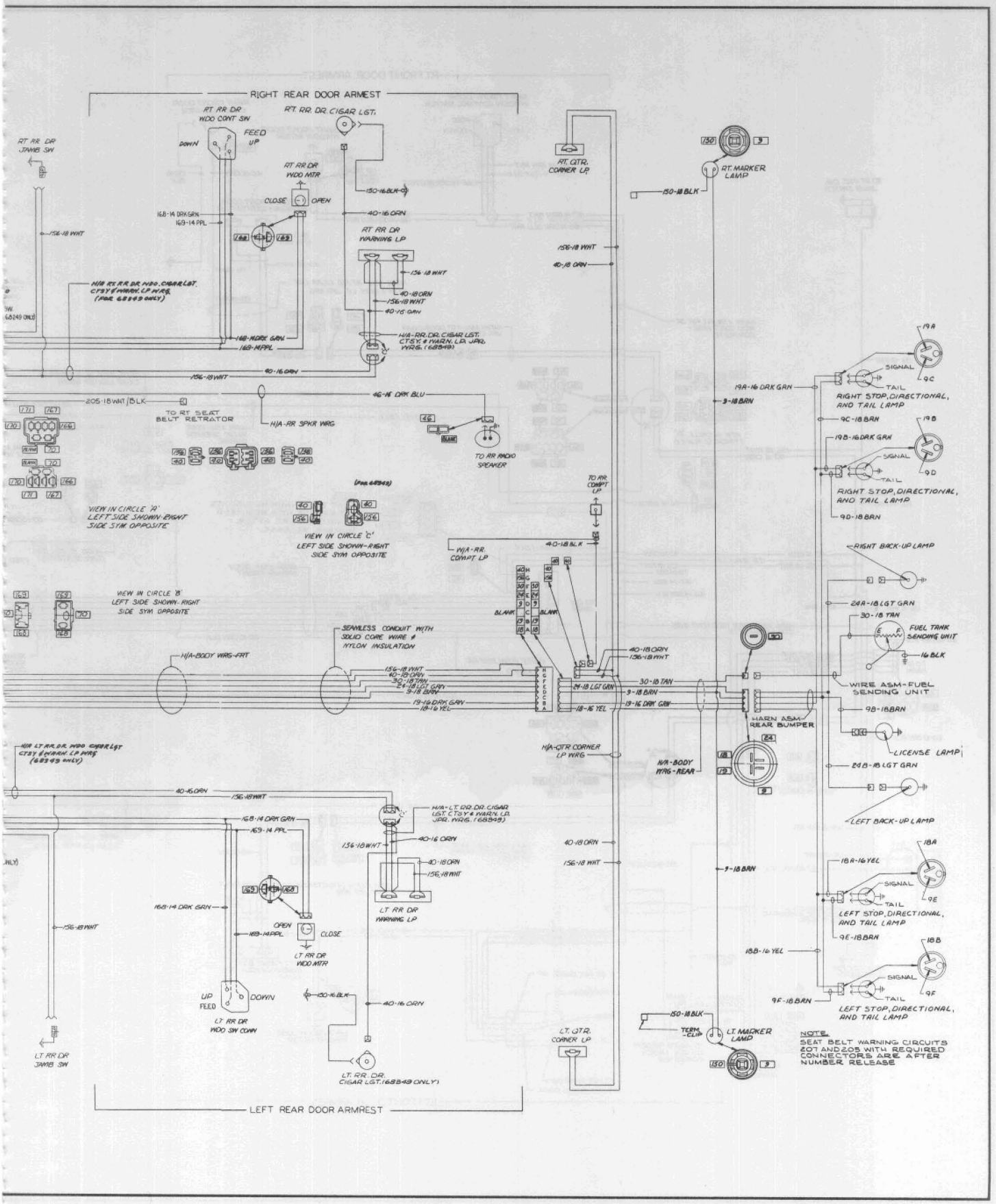


Fig. 12-41 Body Wiring Diagram (68349, 68249)

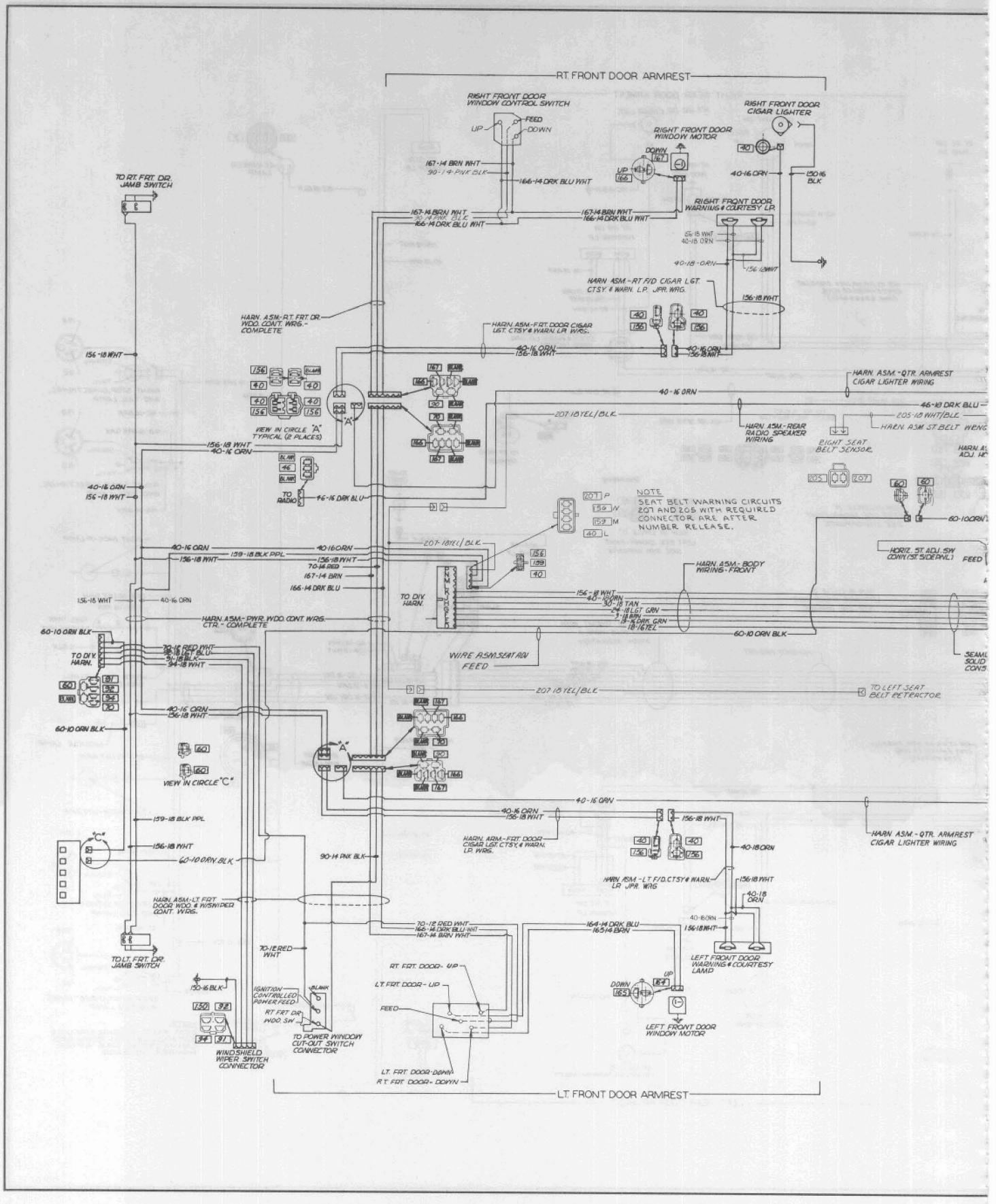


Fig. 12-42 Body Wiring Diagram (69347)

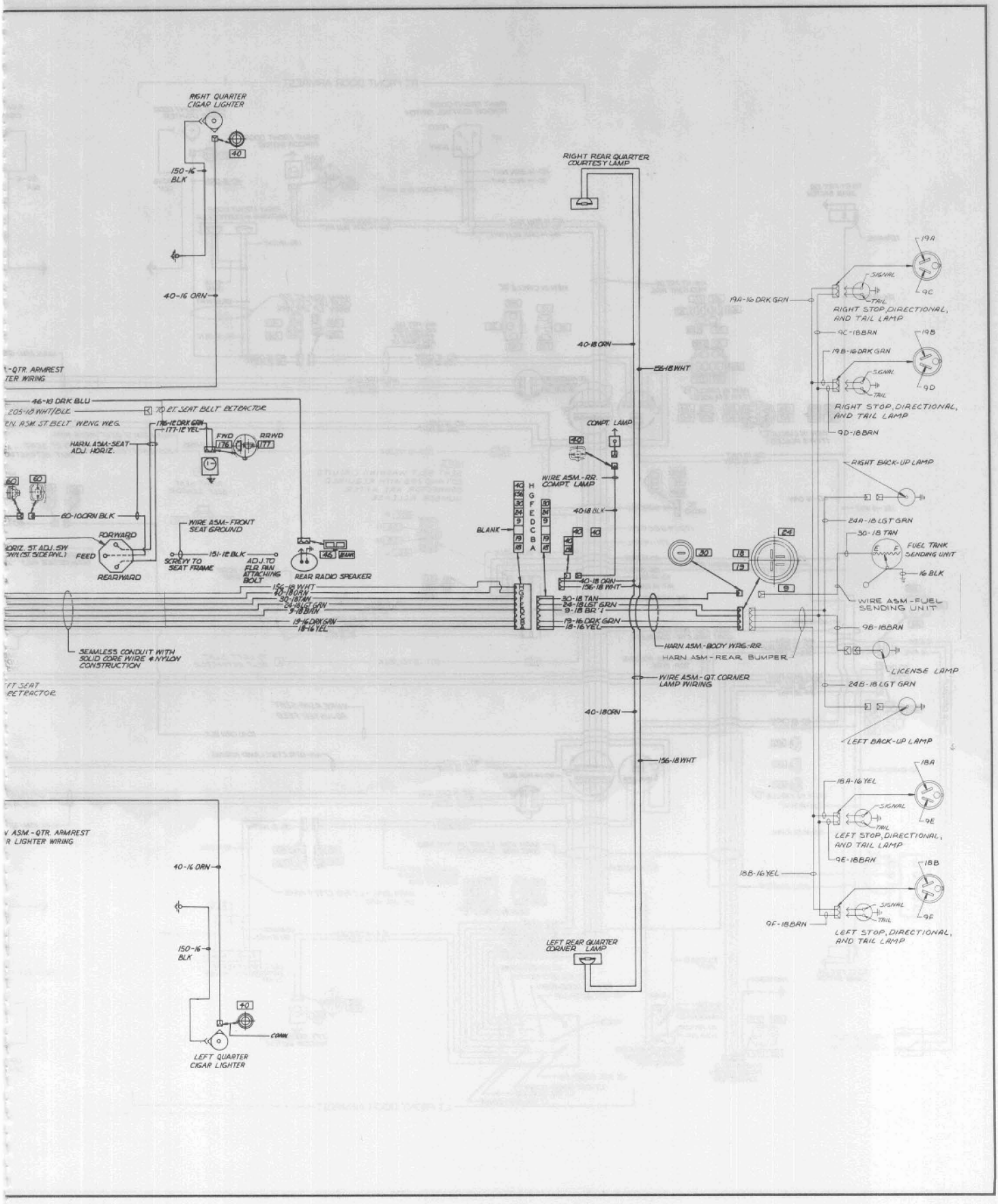


Fig. 12-42 Body Wiring Diagram (69347)

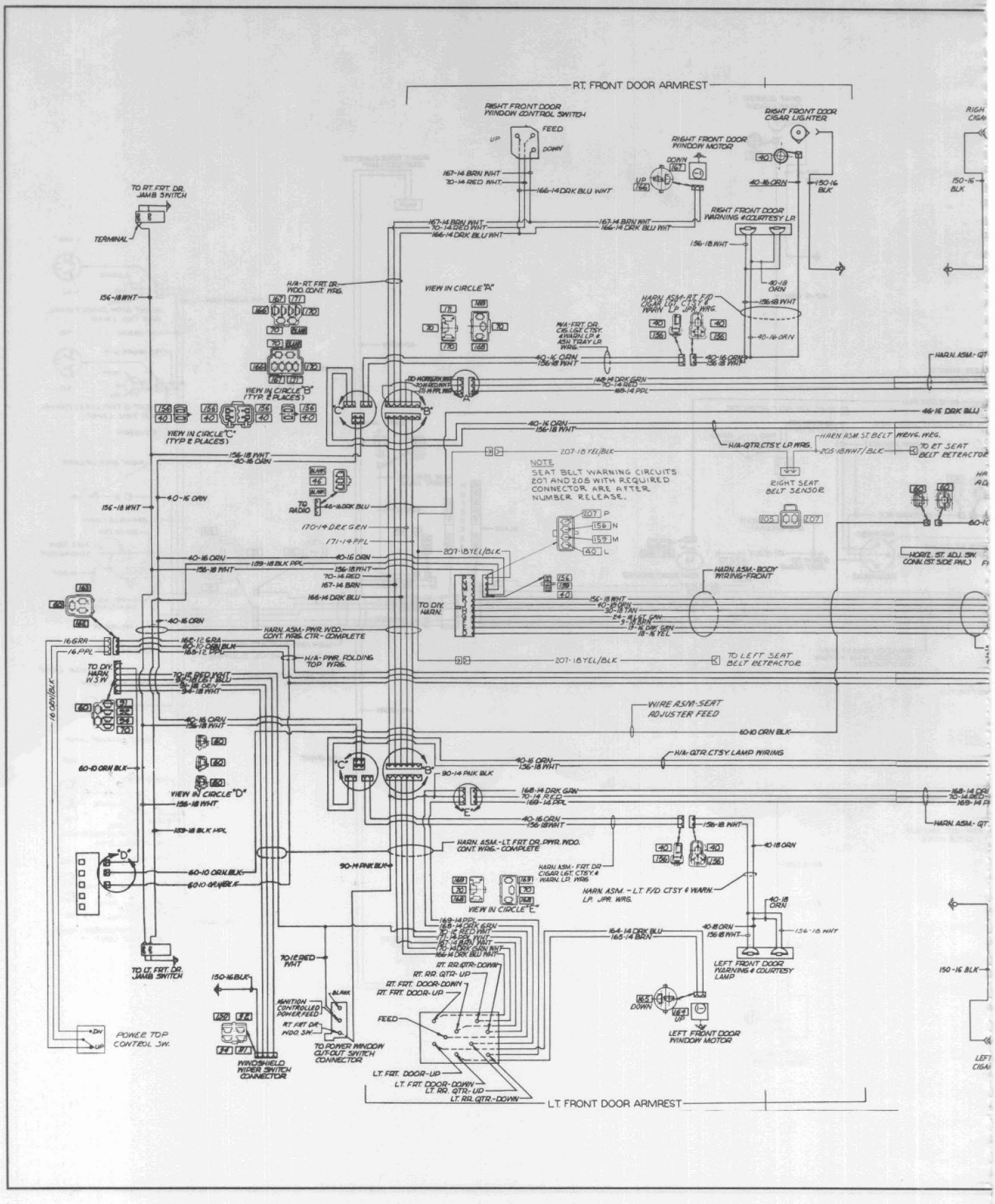


Fig. 12-43 Body Wiring Diagram (69367)

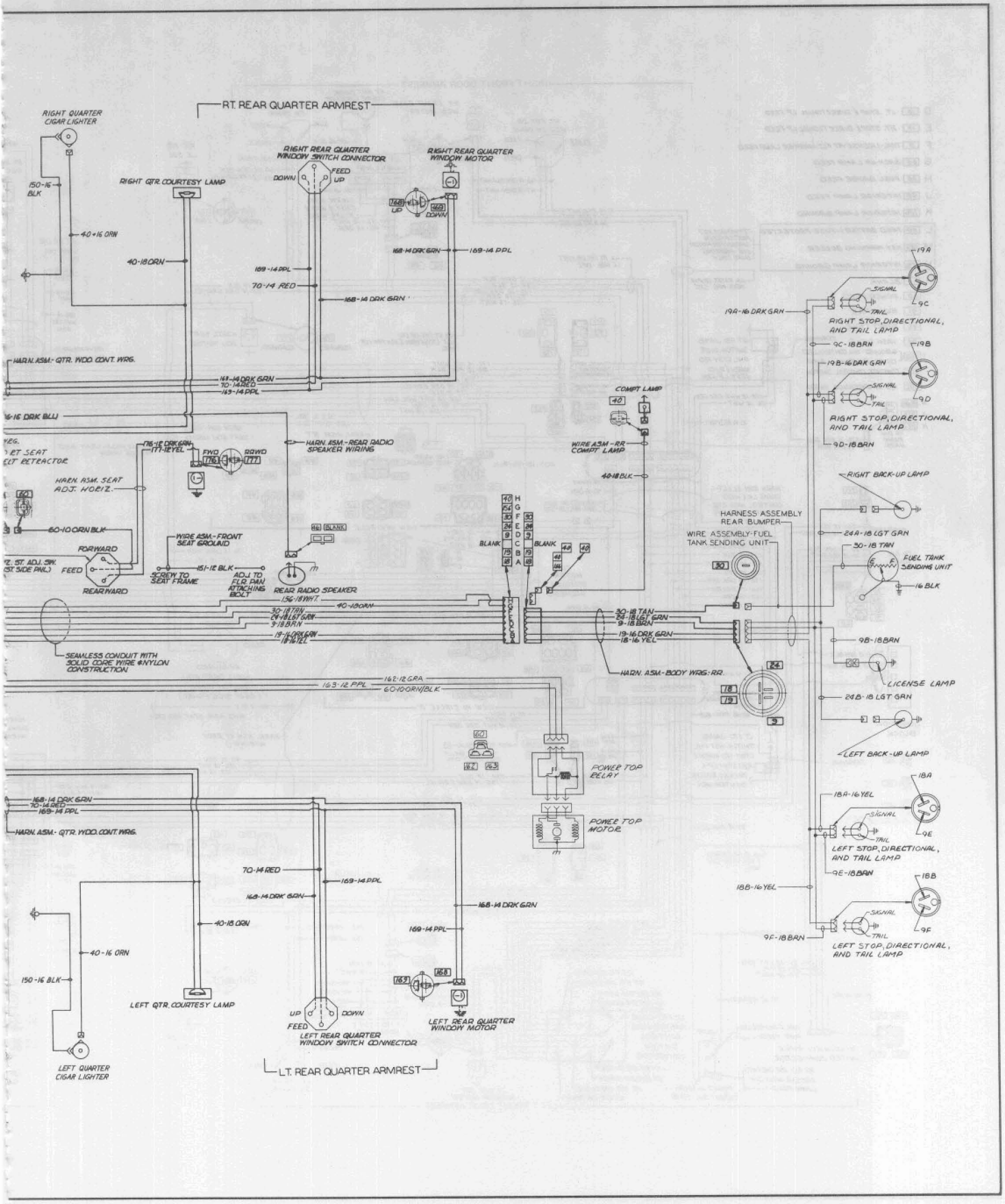


Fig. 12-43 Body Wiring Diagram (69367)

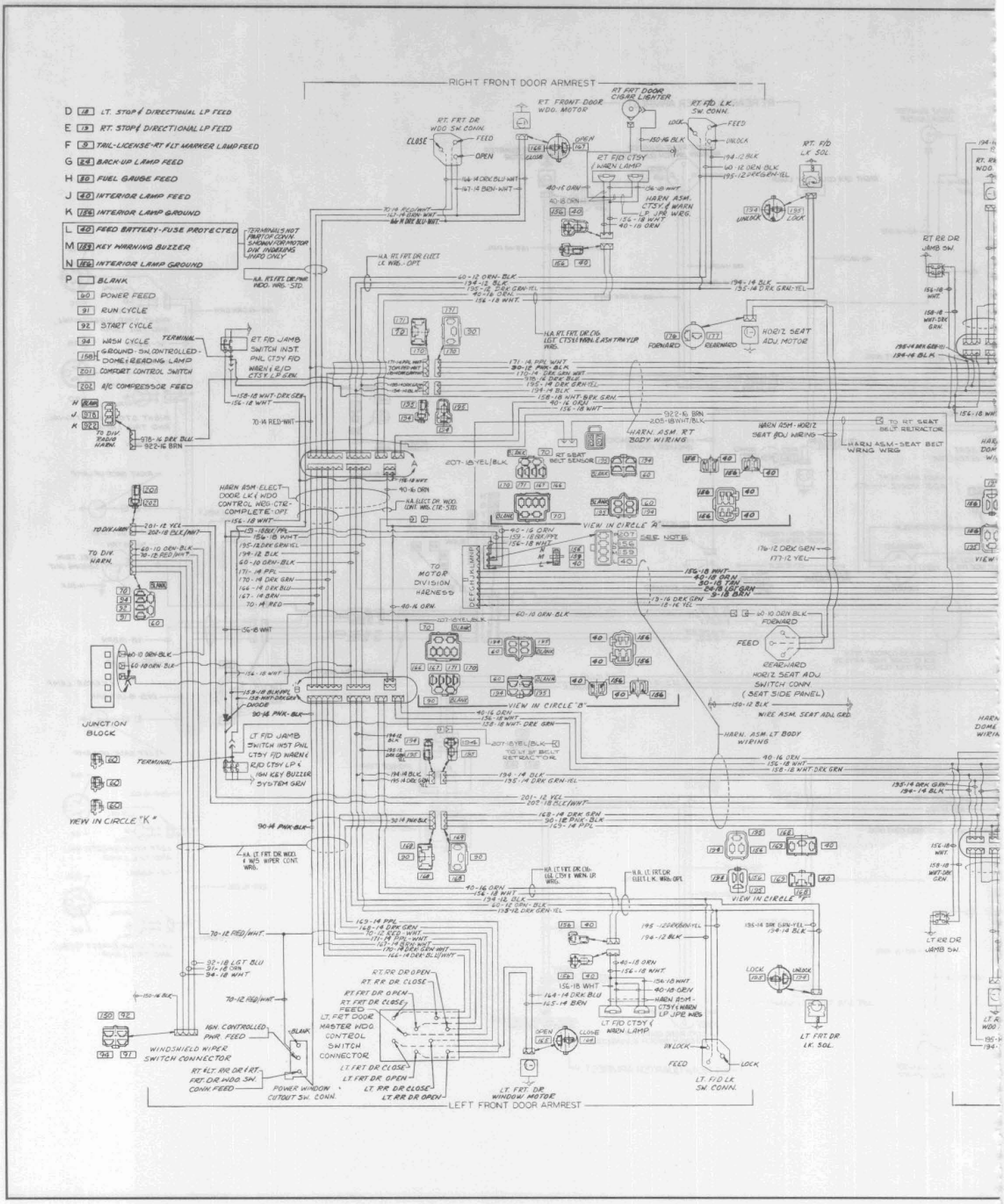


Fig. 12-44 Body Wiring Diagram (69723)

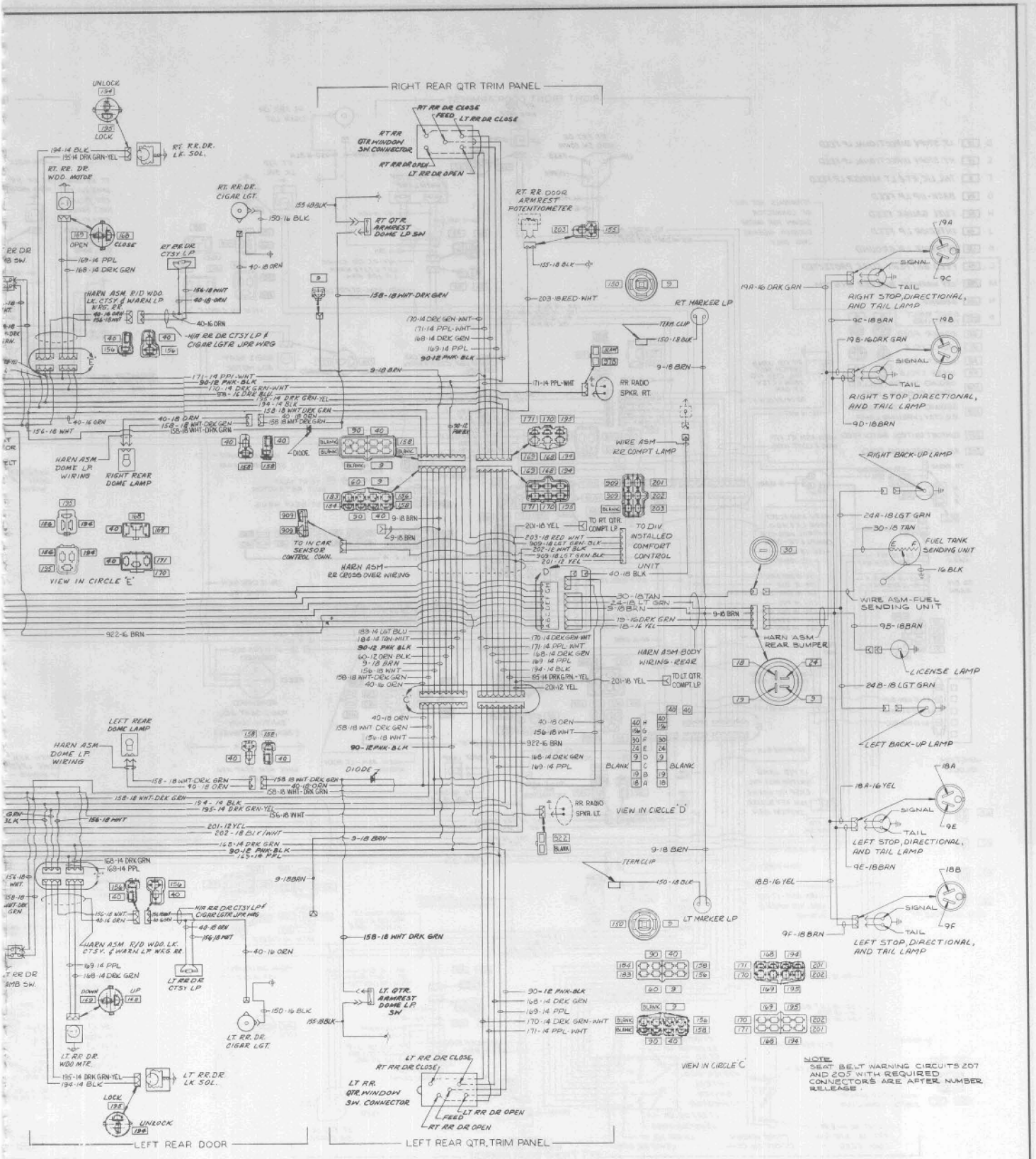


Fig. 12-44 Body Wiring Diagram (69723)

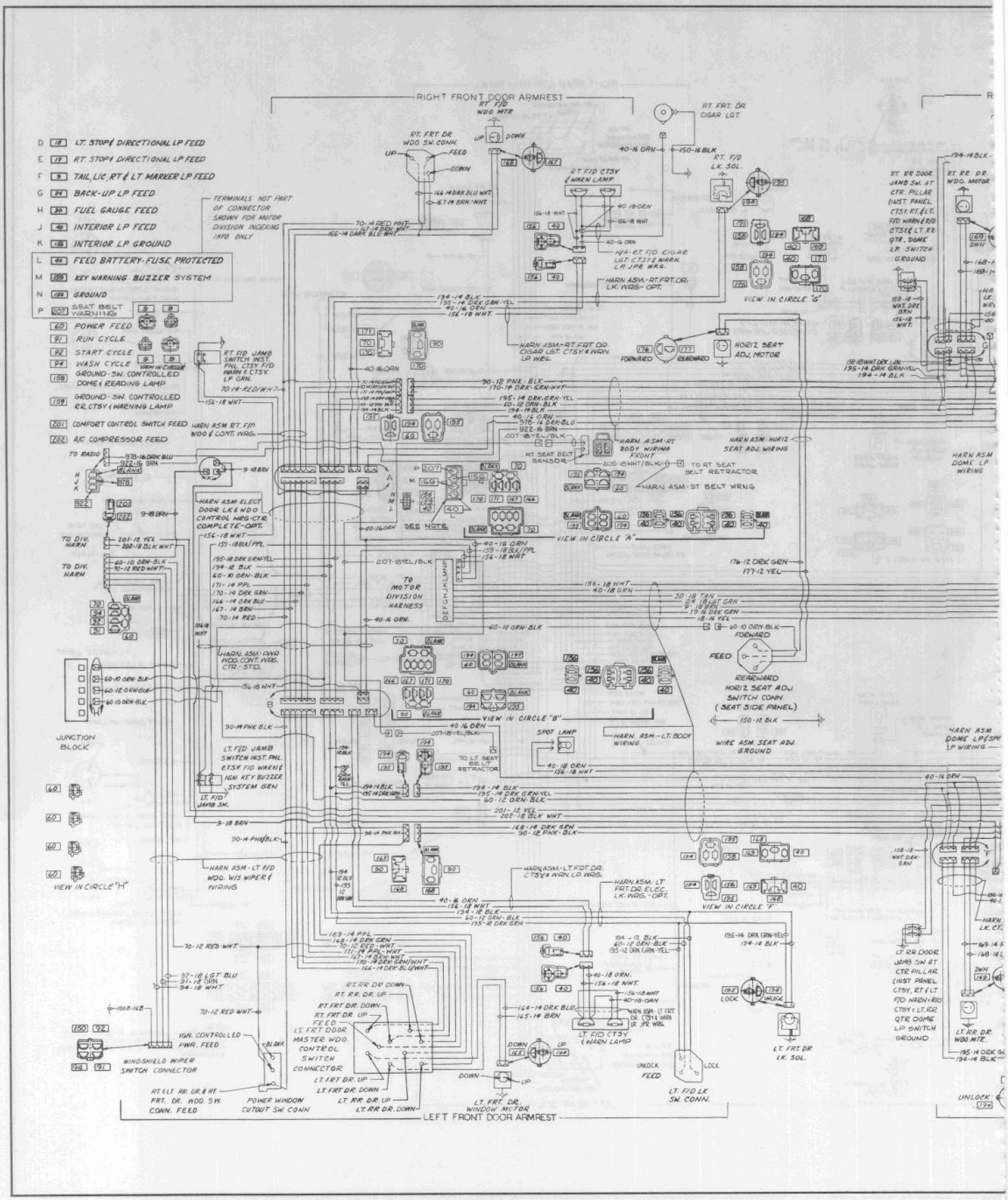


Fig. 12-45 Body Wiring Diagram (69733)

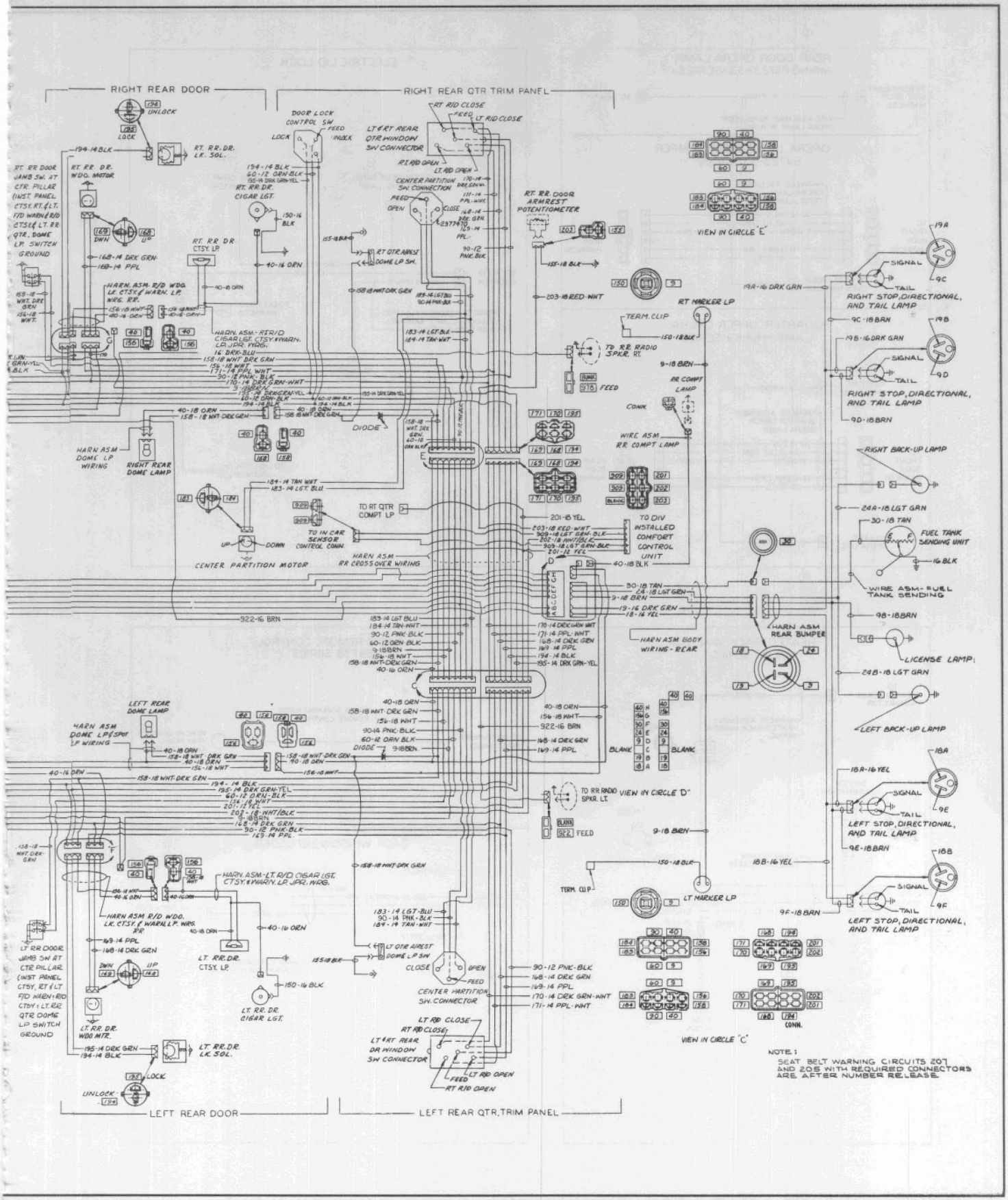


Fig. 12-45 Body Wiring Diagram (69733)

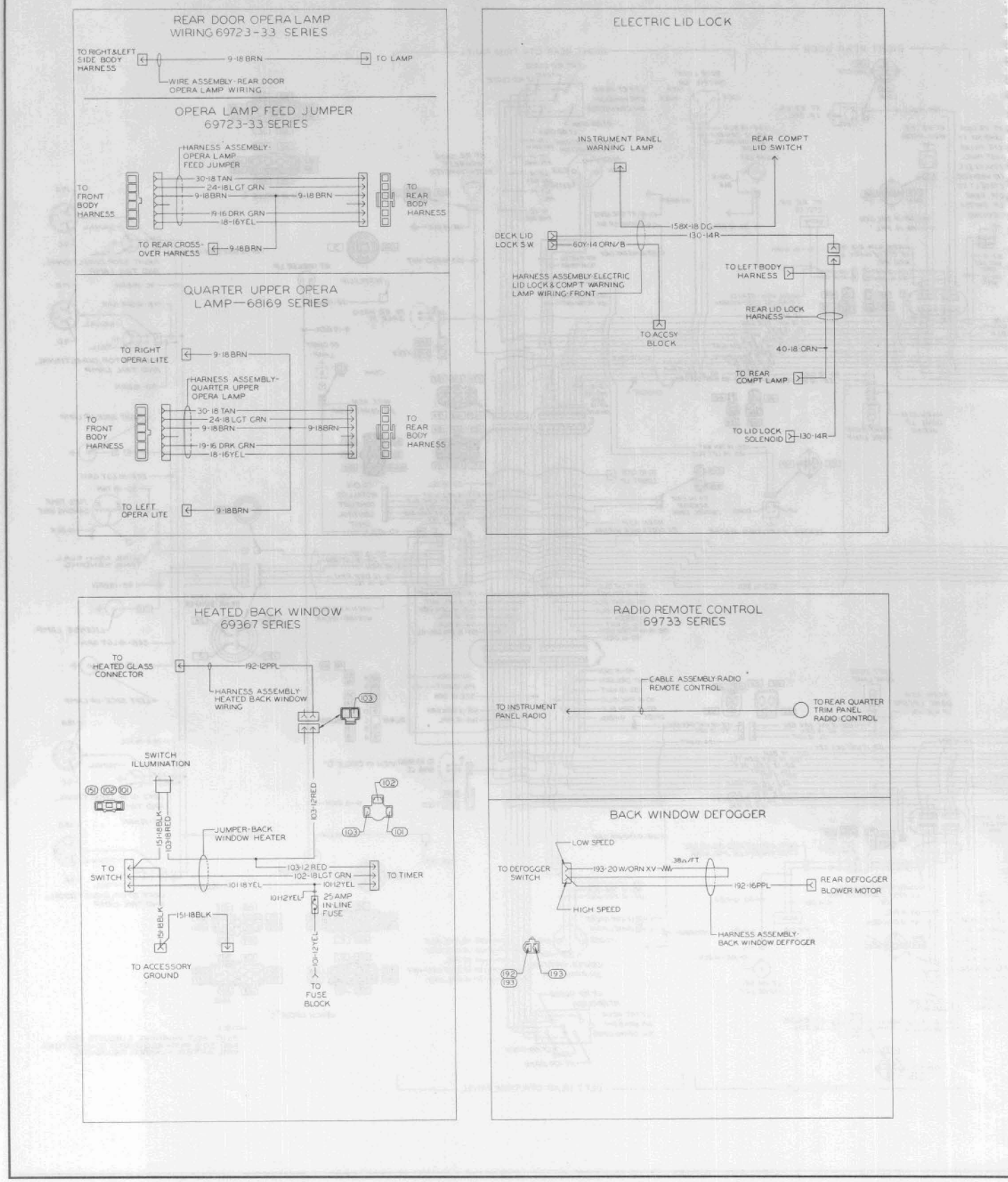
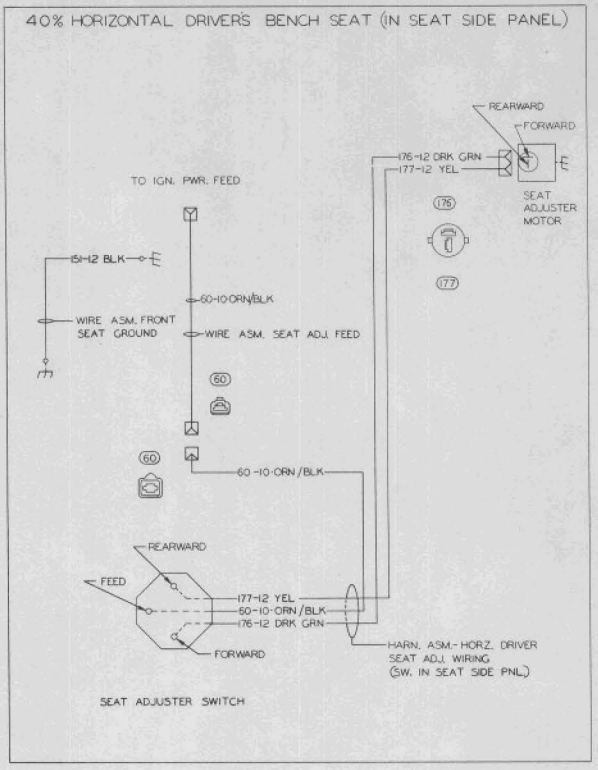
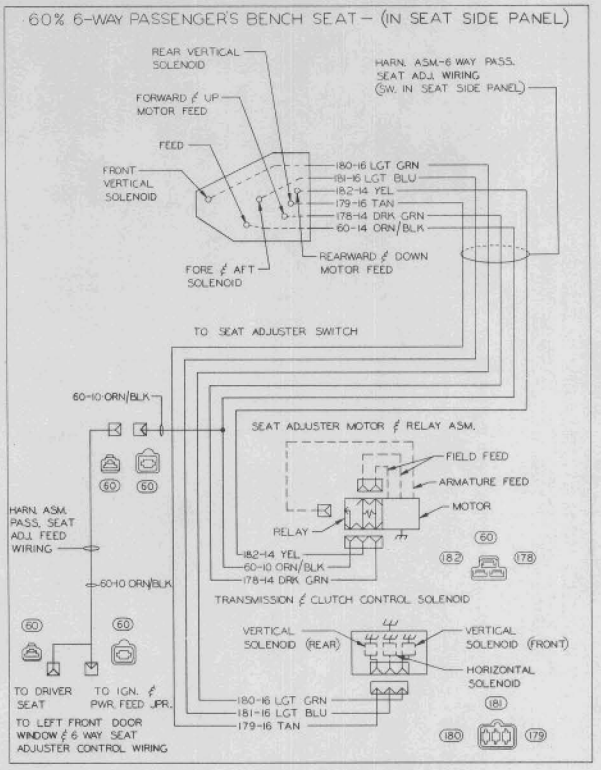
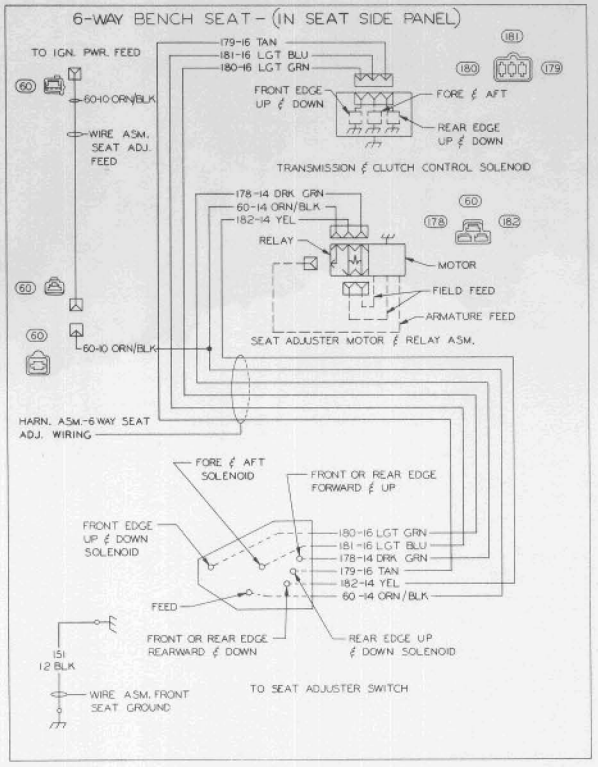


Fig. 12-46 Optional Body Wiring







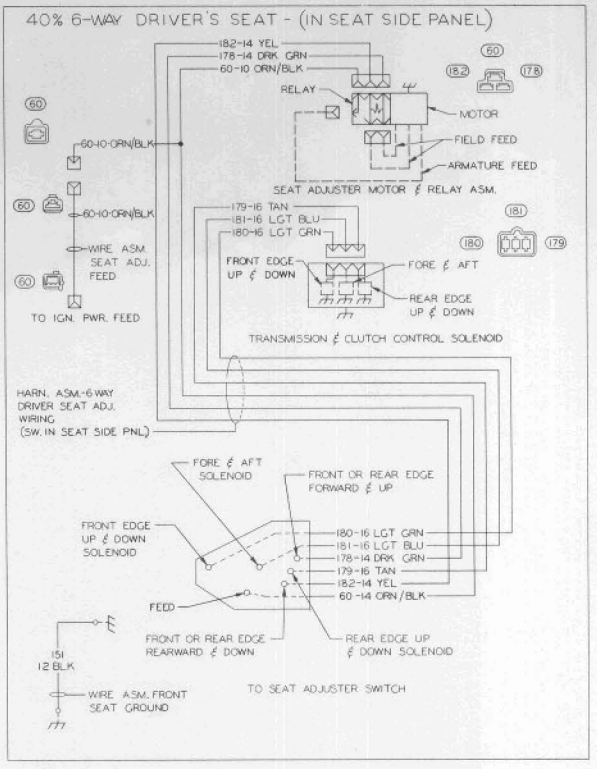
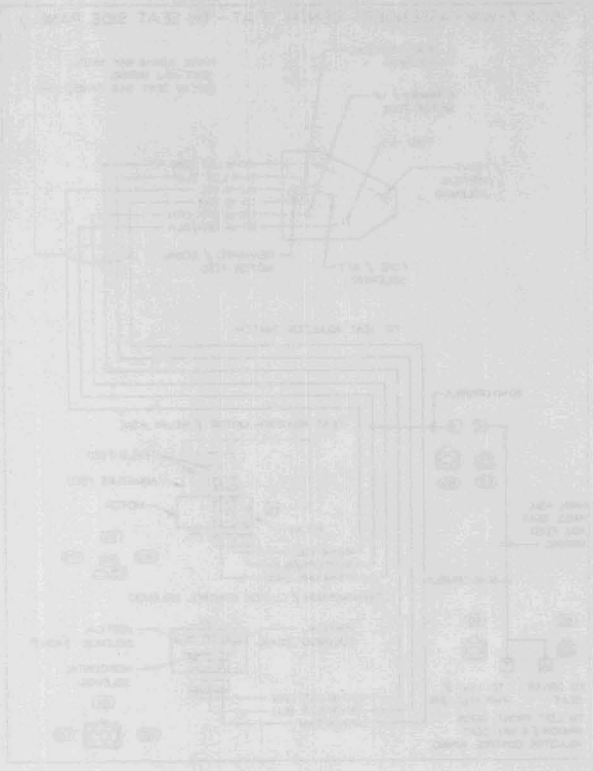
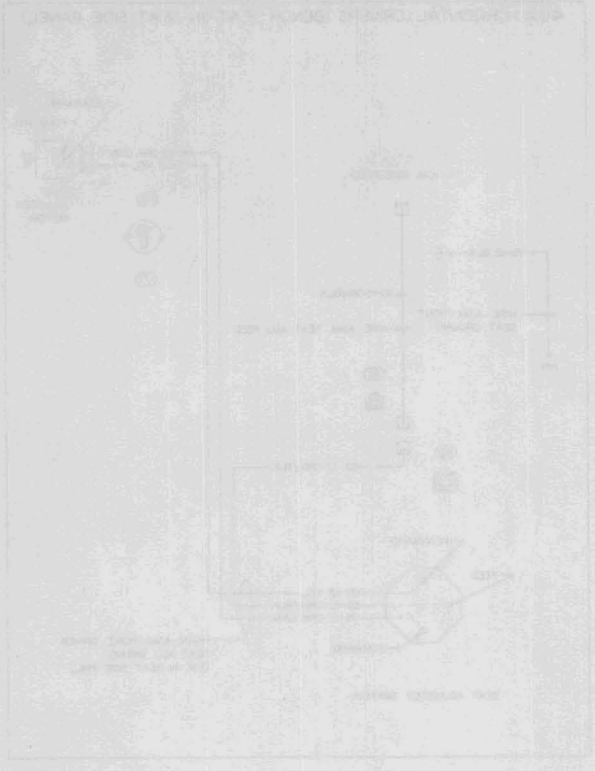


Fig. 12-46 Optional Body Wiring





GENERAL DESCRIPTION

(NOTE: For information pertaining to the Eldorado radiator and grille, refer to the latter portion of this section.)

Radiator

All 1972 Cadillac vehicles use a crossflow radiator as part of the engine closed cooling system. The radiator is constructed with two vertical tanks that connect to the enclosed crossflow tubing. The radiator filler neck, vented pressure cap, and coolant reservoir tube are located on the corner of the right tank.

A radiator coolant reservoir is located on the left side of the radiator. Service information pertaining to the coolant reservoir is covered in Section 6, Note 4.

Grille

The 1972 Cadillac grille assembly is of injection-molded plastic construction consisting of a pattern of horizontal and vertical chrome-plated fins. Removal of the grille assembly may be accomplished without removing the front bumper.

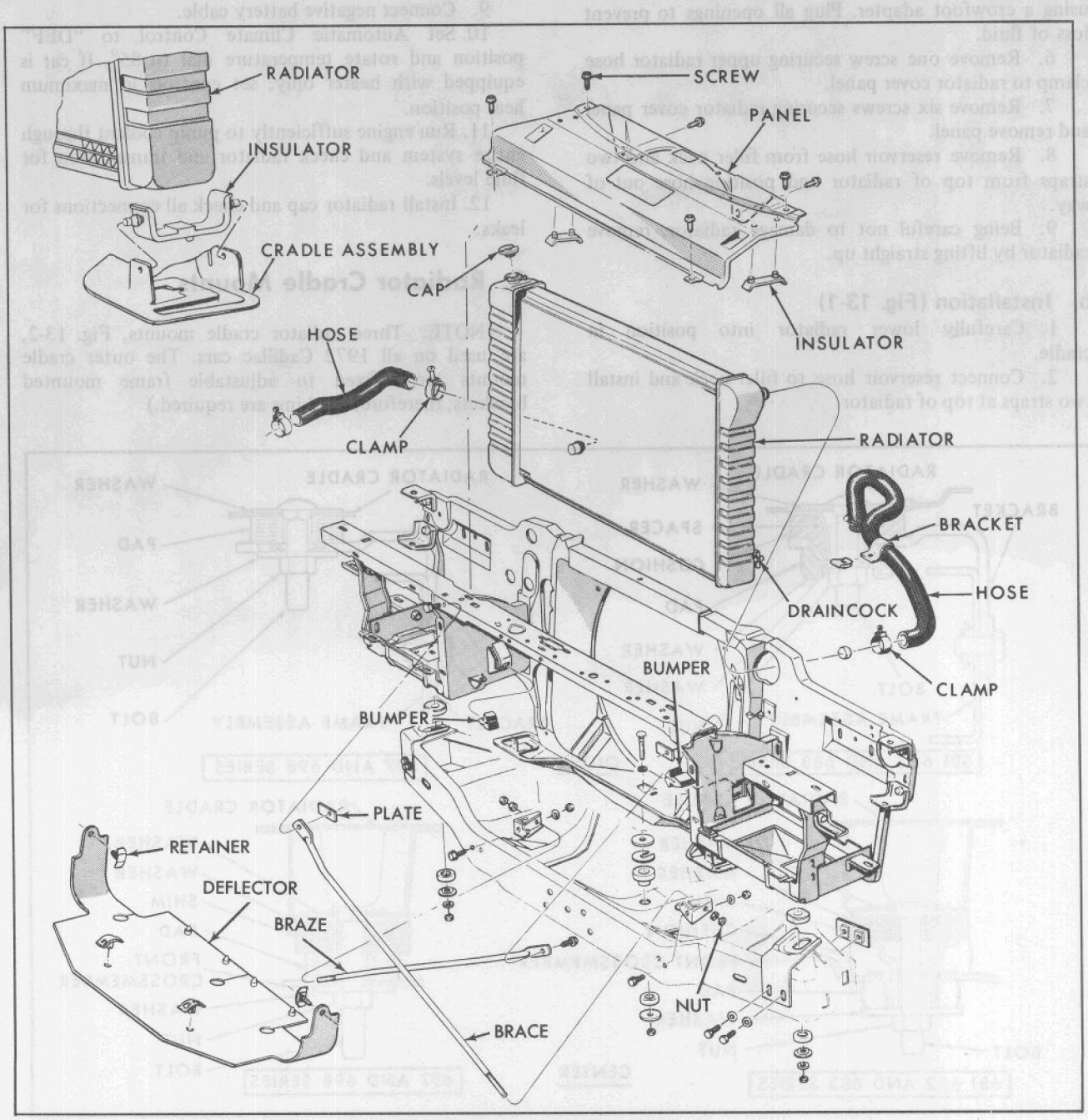


Fig. 13-1 Radiator and Cradle Assembly

13

SERVICE INFORMATION

1. Radiator

a. Removal (Fig. 13-1)

1. Disconnect negative battery cable.
2. Place drain pan under radiator and open drain cock at bottom left corner of radiator. Remove radiator cap so coolant will flow freely.
3. Loosen hose clamps and disconnect upper and lower radiator hoses at radiator.
4. Loosen clamp and disconnect heater return hose at right radiator tank.
5. Disconnect two transmission cooler lines at transmission fluid cooler tank on right side of radiator, using a crowfoot adapter. Plug all openings to prevent loss of fluid.
6. Remove one screw securing upper radiator hose clamp to radiator cover panel.
7. Remove six screws securing radiator cover panel and remove panel.
8. Remove reservoir hose from filler neck and two straps from top of radiator and position hose out of way.
9. Being careful not to damage radiator, remove radiator by lifting straight up.

b. Installation (Fig. 13-1)

1. Carefully lower radiator into position in cradle.
2. Connect reservoir hose to filler neck and install two straps at top of radiator.
3. Install radiator cover panel and secure with six screws.
4. Install one screw securing upper radiator hose clamp to cover panel.
5. Connect two transmission cooler lines at transmission fluid cooler tank on right side of radiator, using a crowfoot adapter.
6. Connect upper and lower radiator hoses at radiator and secure with hose clamps.
7. Connect heater return hose to right radiator tank.
8. Close radiator drain cock, and fill cooling system with recommended coolant.
9. Connect negative battery cable.
10. Set Automatic Climate Control to "DEF" position and rotate temperature dial to 85°. If car is equipped with heater only, set controls in maximum heat position.
11. Run engine sufficiently to pump coolant through entire system and check radiator and transmission for fluid levels.
12. Install radiator cap and check all connections for leaks.

2. Radiator Cradle Mounts

(NOTE: Three radiator cradle mounts, Fig. 13-2, are used on all 1972 Cadillac cars. The outer cradle mounts are affixed to adjustable frame mounted brackets; therefore, no shims are required.)

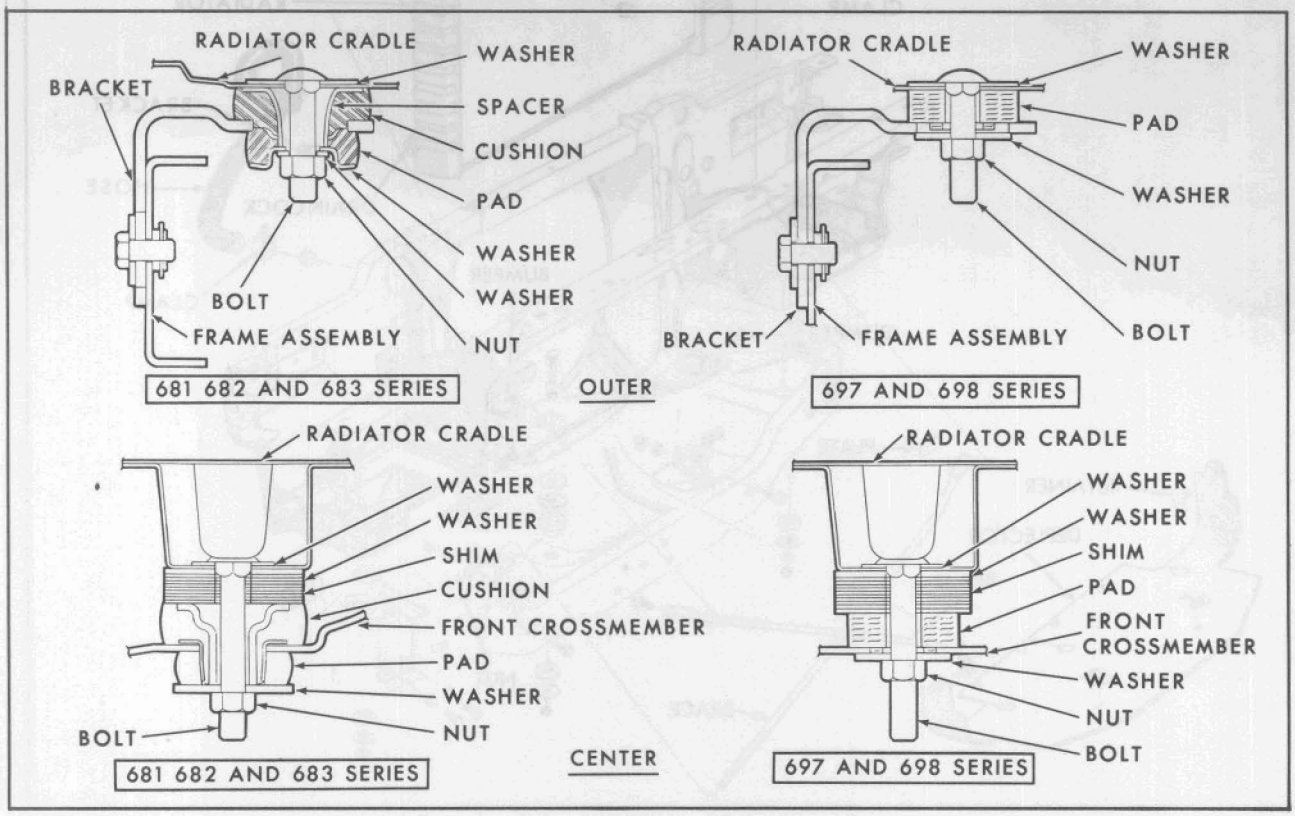


Fig. 13-2 Radiator Cradle Mounts

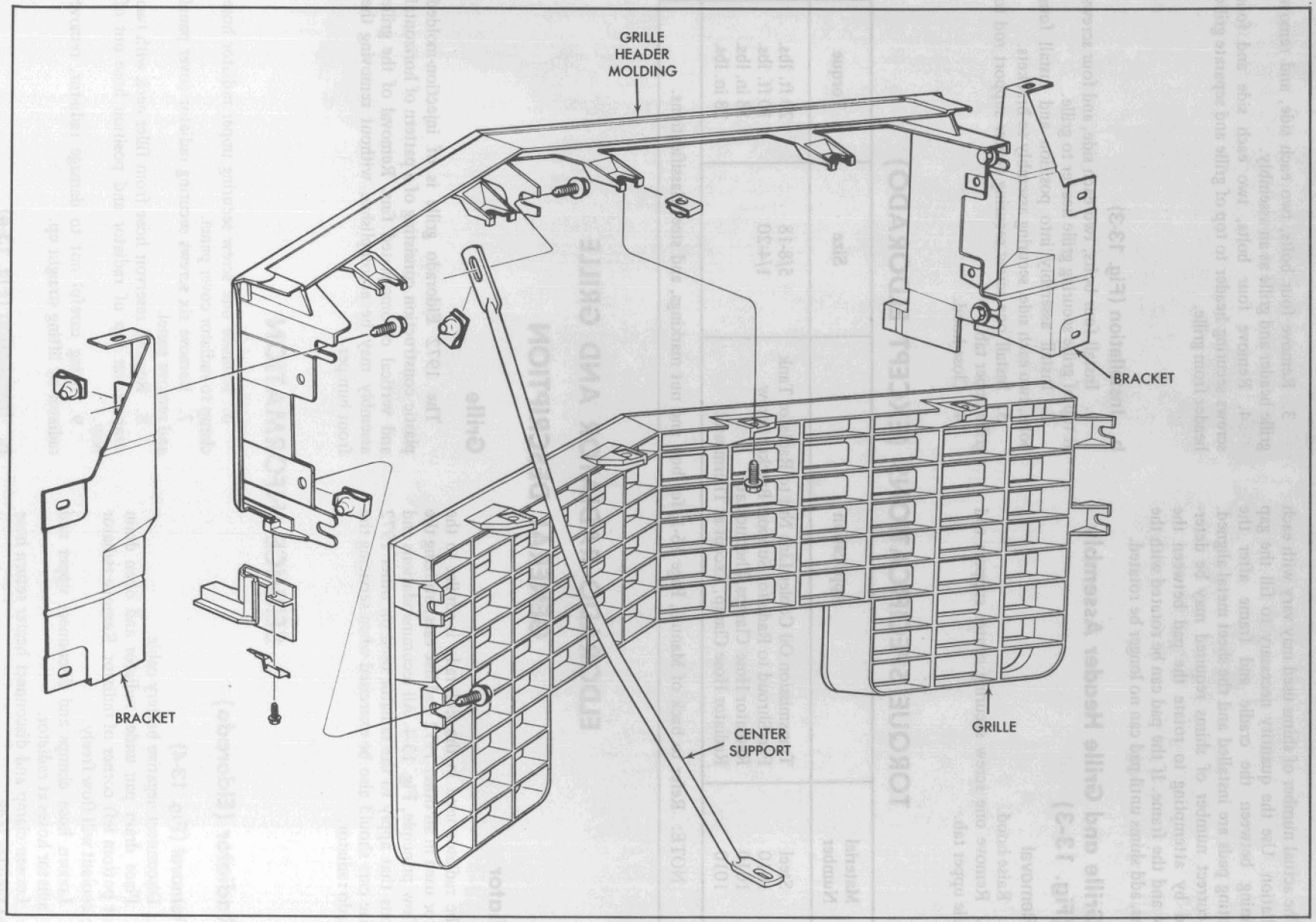


Fig. 13-3 Grille Disassembled

The actual number of shims used may vary with each installation. Use the quantity necessary to fill the gap remaining between the cradle and frame after the mounting pads are installed and the sheet metal aligned. The correct number of shims required may be determined by attempting to rotate the pad between the cradle and the frame. If the pad can be rotated with the fingers, add shims until pad can no longer be rotated.

3. Grille and Grille Header Assembly (Fig. 13-3)

a. Removal

1. Raise hood.
2. Remove one screw securing center support rod to grille upper tab.
3. Remove four bolts, two each side, and remove grille header and grille as an assembly.
4. Remove four bolts, two each side and four screws securing header to top of grille and separate grille header from grille.

b. Installation (Fig. 13-3)

1. Install four bolts, two each side, and four screws at top of grille securing grille header to grille.
2. Install assembly into position and install four bolts, two each side, securing assembly to brackets.
3. Install one screw securing center support rod to grille upper tab.
4. Close hood.

TORQUE SPECIFICATIONS (EXCEPT ELDORADO)

Material Number	Application	Size	Torque
Steel	Transmission Oil Cooler Line Nut to Radiator Tank	5/8-18	20 ft. lbs.
1010	Fan Shroud to Radiator Support Bracket Screw	1/4-20	10 ft. lbs.
1010	Radiator Hose Clamps, Thermostat		18 in. lbs.
1010	Radiator Hose Clamp, Except at Thermostat		28 in. lbs.
NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings, and steel classifications.			

ELDORADO RADIATOR AND GRILLE

GENERAL DESCRIPTION

Radiator

The radiator used in the Eldorado is similar to the radiator used in all other 1972 Cadillac cars, utilizing the crossflow principle, Fig. 13-4. All recommendations and cautions that apply to the radiator used on other 1972 Cadillac cars should also be exercised when servicing the Eldorado radiator.

Grille

The 1972 Eldorado grille is of injection-molded plastic construction consisting of a pattern of horizontal and vertical chrome-plated fins. Removal of the grille assembly may be accomplished without removing the front bumper.

SERVICE INFORMATION

4. Radiator (Eldorado)

a. Removal (Fig. 13-4)

1. Disconnect negative battery cable.
2. Place drain pan under radiator and open drain cock at bottom left corner of radiator. Remove radiator cap so coolant will flow freely.
3. Loosen hose clamps and disconnect upper and lower radiator hoses at radiator.
4. Loosen clamp and disconnect heater return hose at right radiator tank.
5. Disconnect two transmission cooler lines at transmission fluid cooler tank on right side of radiator. Plug all openings to prevent loss of fluid.
6. Remove one screw securing upper radiator hose clamp to radiator cover panel.
7. Remove six screws securing radiator cover panel and remove panel.
8. Remove reservoir hose from filler neck with two straps from top of radiator and position hose out of way.
9. Being careful not to damage radiator, remove radiator by lifting straight up.

b. Installation (Fig. 13-4)

1. Carefully lower radiator into position in cradle.
2. Connect reservoir hose to filler neck and install two straps at top of radiator.

3. Install radiator cover panel and secure with six screws.

4. Connect two transmission cooler lines at transmission fluid cooler tank on right side of radiator.

5. Connect upper and lower radiator hoses at radiator and secure with hose clamps.

6. Install radiator hose clamp at cover panel and secure with one screw.

7. Connect heater return hose to right radiator tank.

8. Close radiator drain cock and fill cooling system with recommended coolant.

9. Connect negative battery cable.

10. Set Automatic Climate Control to "DEF" position and rotate temperature dial to 85°. If car is equipped with heater only, set controls in maximum heat position.

11. Run engine sufficiently to pump coolant through entire system and check radiator and transmission fluid levels.

12. Install radiator cap and check all connections for leaks.

5. Radiator Cradle Mounts

(NOTE: The center cradle support, Fig. 13-5, incorporates a compression type rubber mount for noise and vibration isolation. The number of shims required is determined by the proper alignment of the front sheet metal to the body shown in Fig. 11-10. After sheet metal alignment is achieved, attempt to rotate the pad between the cradle and frame. If the pad can be rotated with the fingers, add shims until pad can no longer be rotated.)

6. Grille and Grille Header Assembly (Fig. 13-6)

(NOTE: Removal and installation procedures for the grille and grille header assembly on Eldorados is the same as on other 1972 Cadillac cars and is covered in Note 3 of this section.)

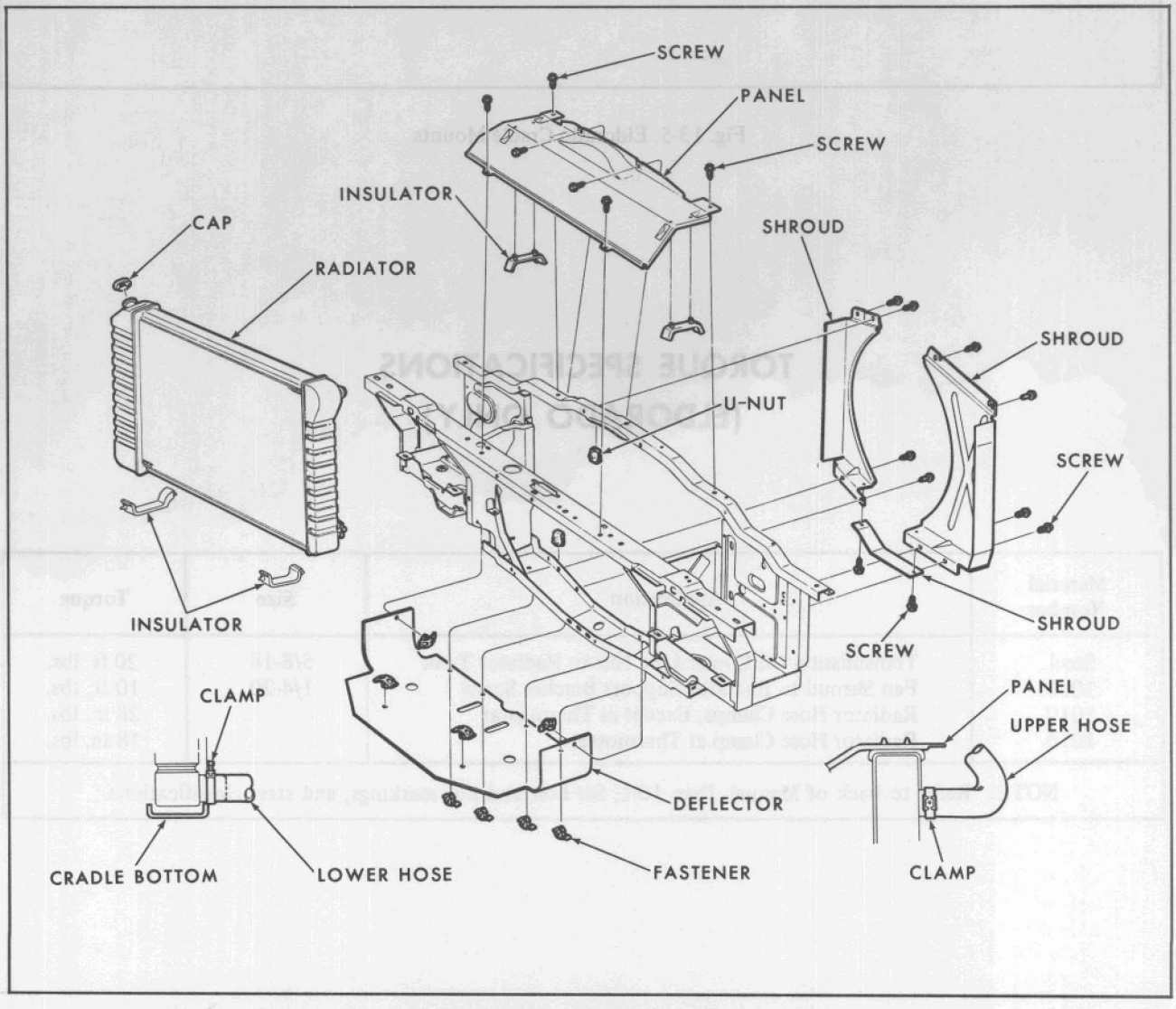


Fig. 13-4 Eldorado Radiator and Cradle Assembly

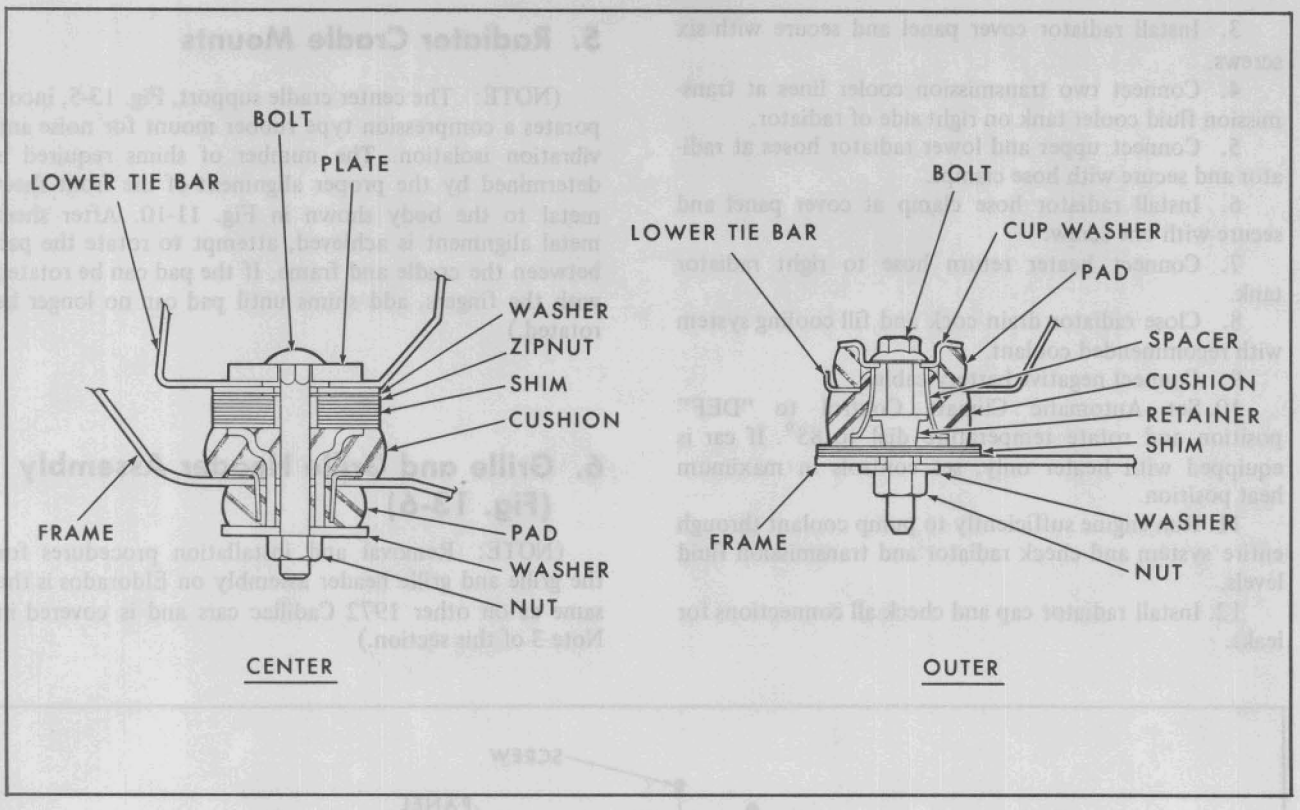


Fig. 13-5 Eldorado Cradle Mounts

TORQUE SPECIFICATIONS (ELDORADO ONLY)

Material Number	Application	Size	Torque
Steel	Transmission Oil Cooler Line Nut to Radiator Tank	5/8-18	20 ft. lbs.
1010	Fan Shroud to Radiator Support Bracket Screw	1/4-20	10 ft. lbs.
1010	Radiator Hose Clamps, Except at Thermostat		28 in. lbs.
1010	Radiator Hose Clamp at Thermostat		18 in. lbs.
NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings, and steel classifications.			

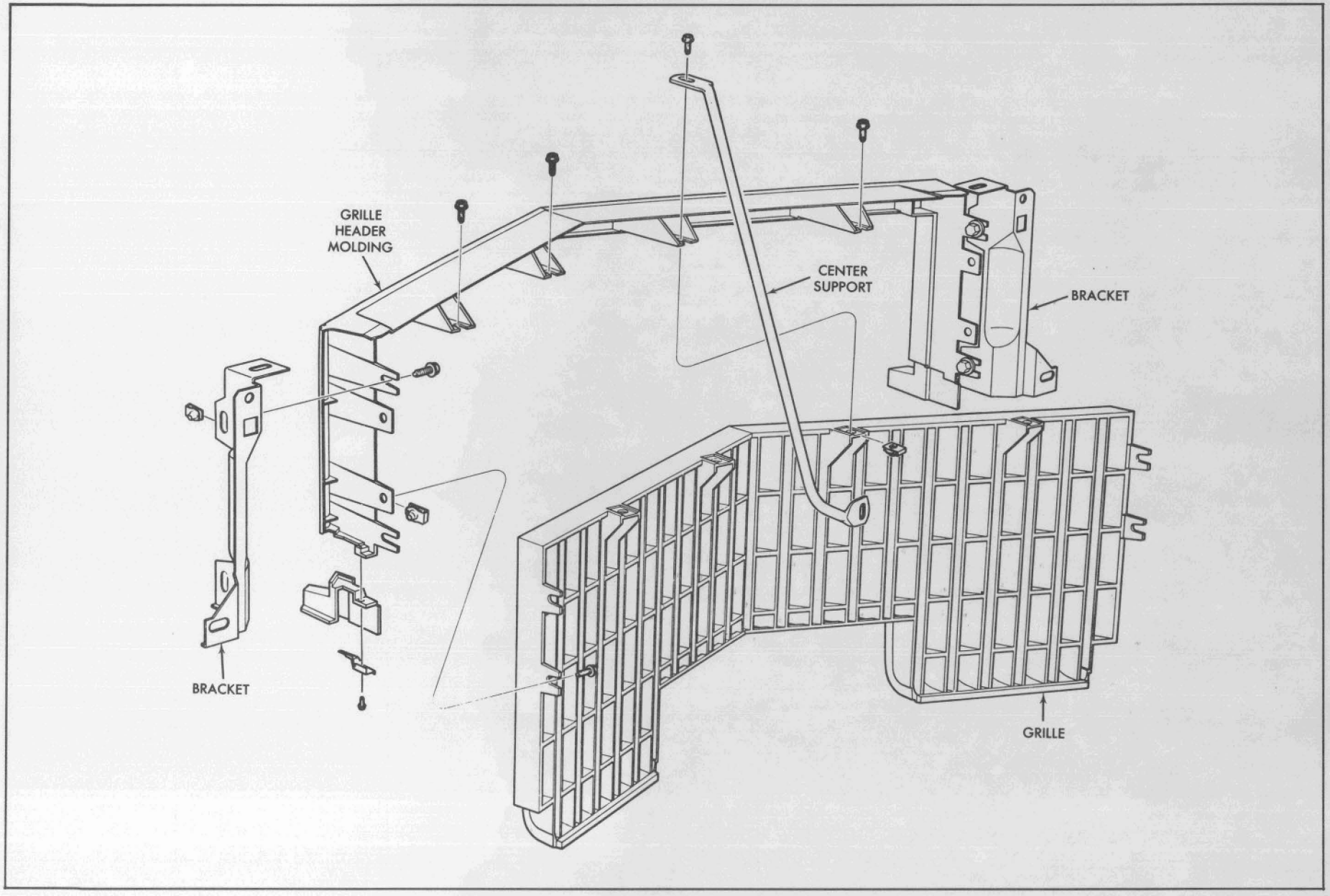
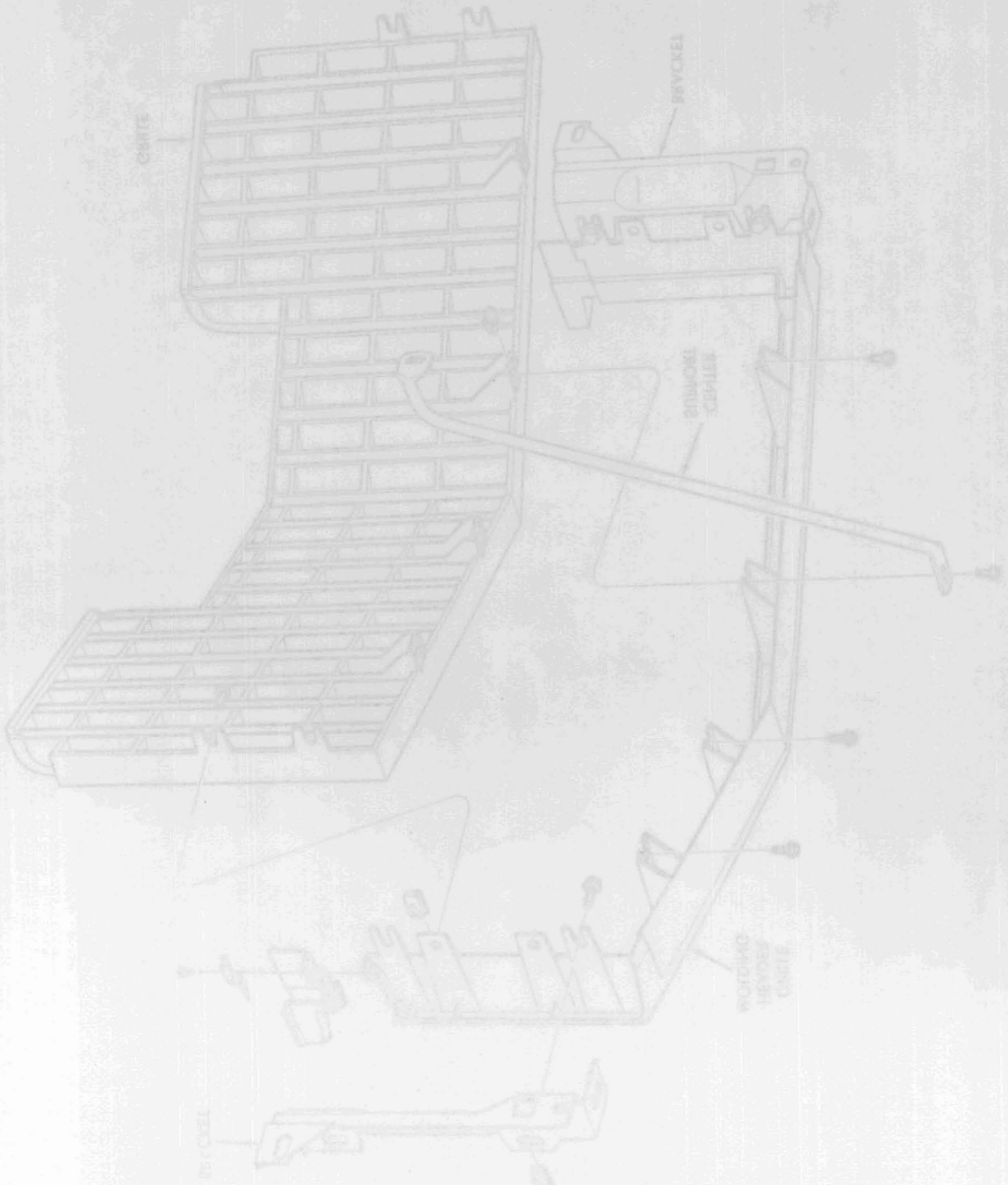


Fig. 13-6 Eldorado Grille Disassembled



GENERAL DESCRIPTION

(NOTE: For information pertaining to the Eldorado (693) bumpers, refer to the latter portion of this section.)

The 1972 Cadillac front bumper assembly, Fig. 14-1, is of five-piece construction that includes a sculptured center section with removable bumper guards and one-piece outer impact bars.

The rear bumper assembly, Fig. 14-3, consists of: a one-piece center section, including a fuel filler door that also serves as a license plate holder, and outer ends incorporating integral taillight assemblies.

Front and rear bumpers are equipped with impact pad assemblies.

SERVICE INFORMATION

1. Front Bumper Assembly

a. Removal (Fig. 14-1)

(NOTE: If car is equipped with lamp monitoring system, it will have a wire at each lamp assembly that must be disconnected before bumper can be removed.)

1. Raise front end of car.

(NOTE: Place a piece of masking tape on the lower edge of the front fender side marker light and between the headlamps on both sides of car. Tape the comparable bumper areas. Draw horizontal and vertical crossed lines on each piece of tape. Measure and record the distance between each of the four horizontal line points for reinstallation.)

2. Position a hydraulic jack so as to support bumper assembly at center.
3. Remove nut, lockwasher, flat washer and bolt securing acromat to rear outer bumper ends.
4. Remove three nuts, flat washers and bolts, each side, securing bumper outer mounting brackets to frame.
5. Remove one nut, flat washer, and bolt, each side, securing outer mounting brackets to outer supports.
6. Remove two nuts, flat washers, and bolts, each side, securing bumper center mounting brackets to frame front cross member and lower bumper slightly to remove center acromat fasteners to bumper brackets.
7. Remove front bumper.

b. Installation (Fig. 14-1)

1. With aid of helper, position front bumper on jack.
2. Raise bumper and position center acromat brackets to front bumper brackets and secure with two clips.
3. Position bumper to car and loosely install two bolts, flat washers and nuts, each side, securing bumper center mounting brackets to frame front cross member.
4. Loosely install three bolts, flat washers and nuts, each side, securing bumper outer mounting brackets to frame.
5. Loosely install one bolt, flat washer, and nut, each side, securing outer mounting brackets to outer supports.
6. Align front bumper and tighten mounting nuts.
7. Position acromat to rear outer bumper ends and secure with bolt, flat washers, lock washer and nut.
8. Remove jack supporting bumper and lower car.

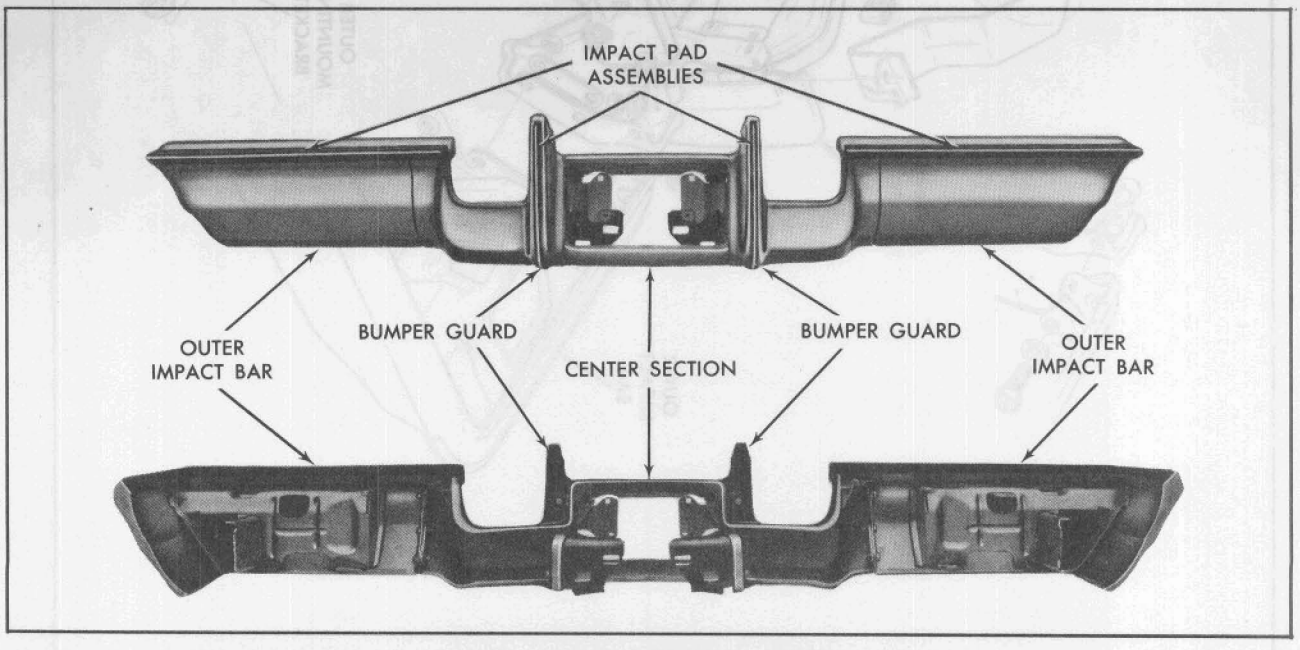


Fig. 14-1 Front Bumper—Front and Rear View

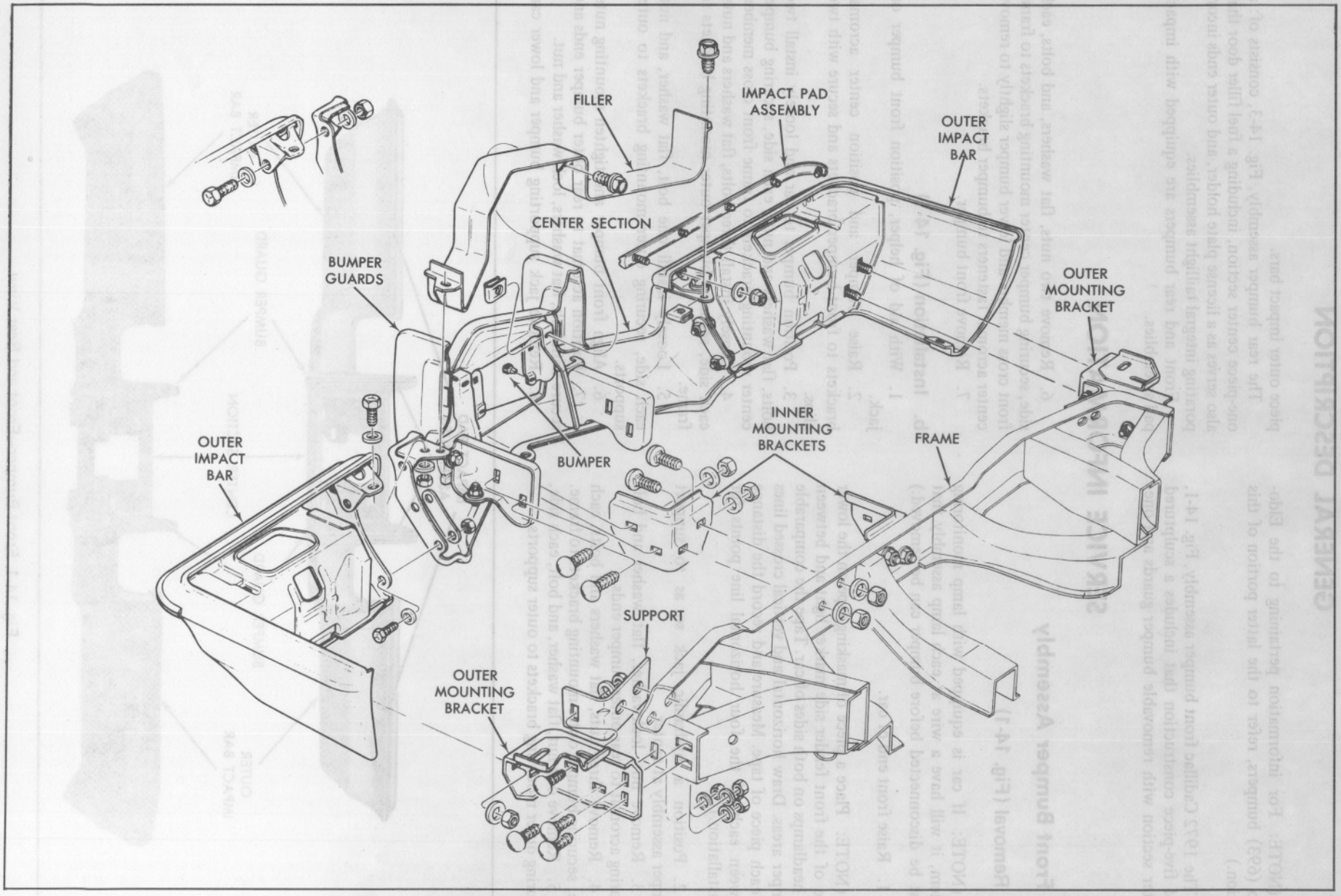


Fig. 14-2 Front Bumper Disassembled

2. Front Bumper Guard—Removal and Installation (On Car)

a. Removal (Fig. 14-2)

1. Raise car.
2. Remove nut, spacer and bolt securing lower end of guard to bottom of bumper.
3. Remove bolt, flat washer, retainer and brace securing bumper guard to front of bumper.
4. Remove bolt, flat washer (and shims if required) securing bumper guard to bumper upper bracket and remove bumper guard.

b. Installation (Fig. 14-2)

1. Position bumper guard to bumper and install bolt, flat washer, (and shims if required) securing bumper guard to bumper upper bracket.
2. Install brace, flat washer, bolt and retainer, securing bumper guard to front of bumper.
3. Install bolt, spacer and nut securing lower end of guard to bottom of bumper.
4. Lower car.

3. Front Bumper Outer Impact Bar—Right or Left

a. Disassembly (Fig. 14-2)

1. Remove front bumper as described in Note 1a.
2. Remove four nuts, flat washers, bolts and one reinforcement securing bumper outer impact bar to center impact bar and remove outer bar.

b. Assembly (Fig. 14-2)

1. Position outer impact bar to center impact bar and secure with one reinforcement and four bolts, flat washers and nuts.
2. Install front bumper as described in Note 1b.

4. Front Bumper Center Section

a. Disassembly (Fig. 14-2)

1. Remove front bumper as described in Note 1a.
2. Remove both outer impact bars as described in Note 3a.
3. Remove center section.
4. Remove center section extensions which are snap fit into position.
5. Remove four bolts securing filler to bumper center section.

b. Assembly (Fig. 14-2)

1. Install four bolts securing filler to bumper center section.
2. Install center section extensions by snapping into position.
3. Install center section.

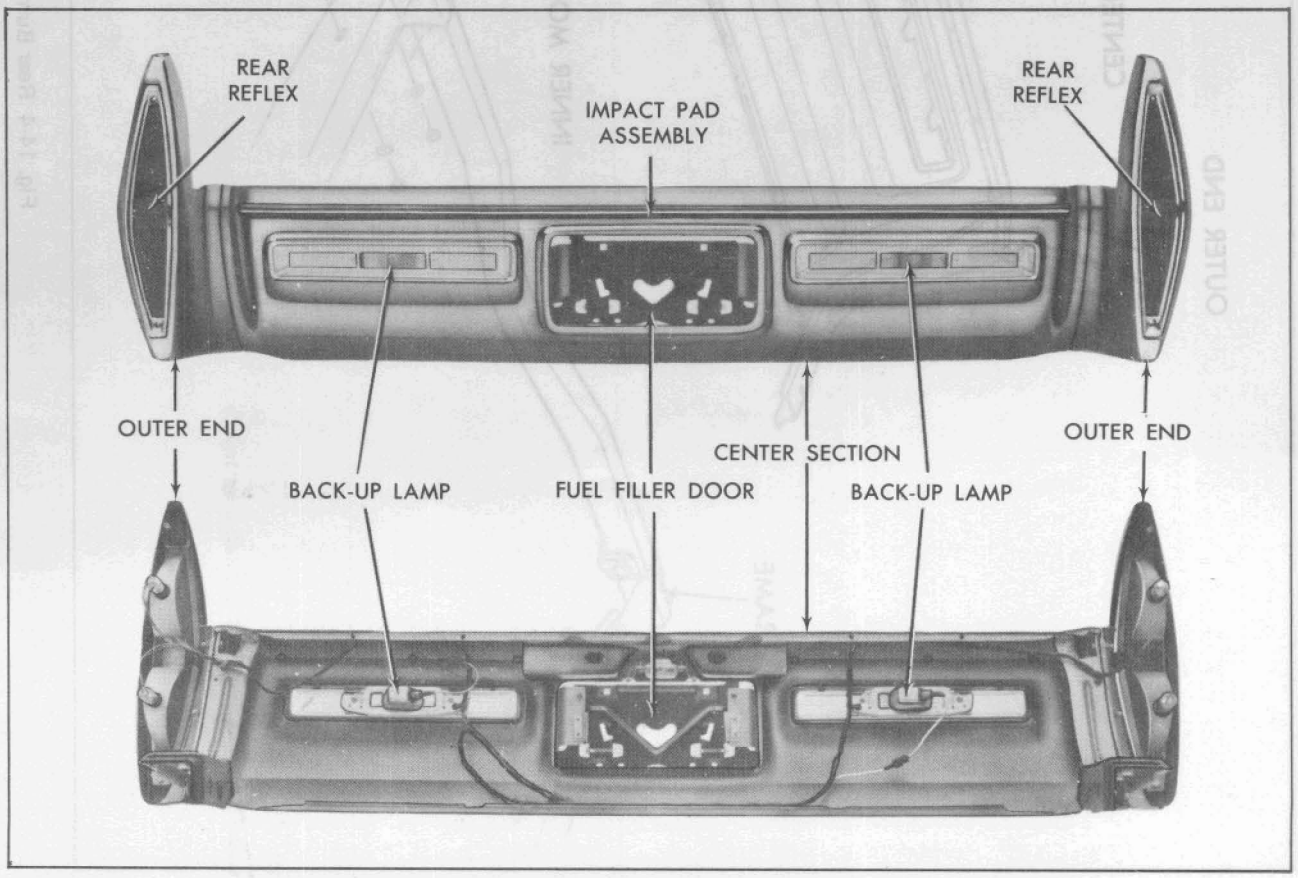


Fig. 14-3 Rear Bumper—Front & Rear View

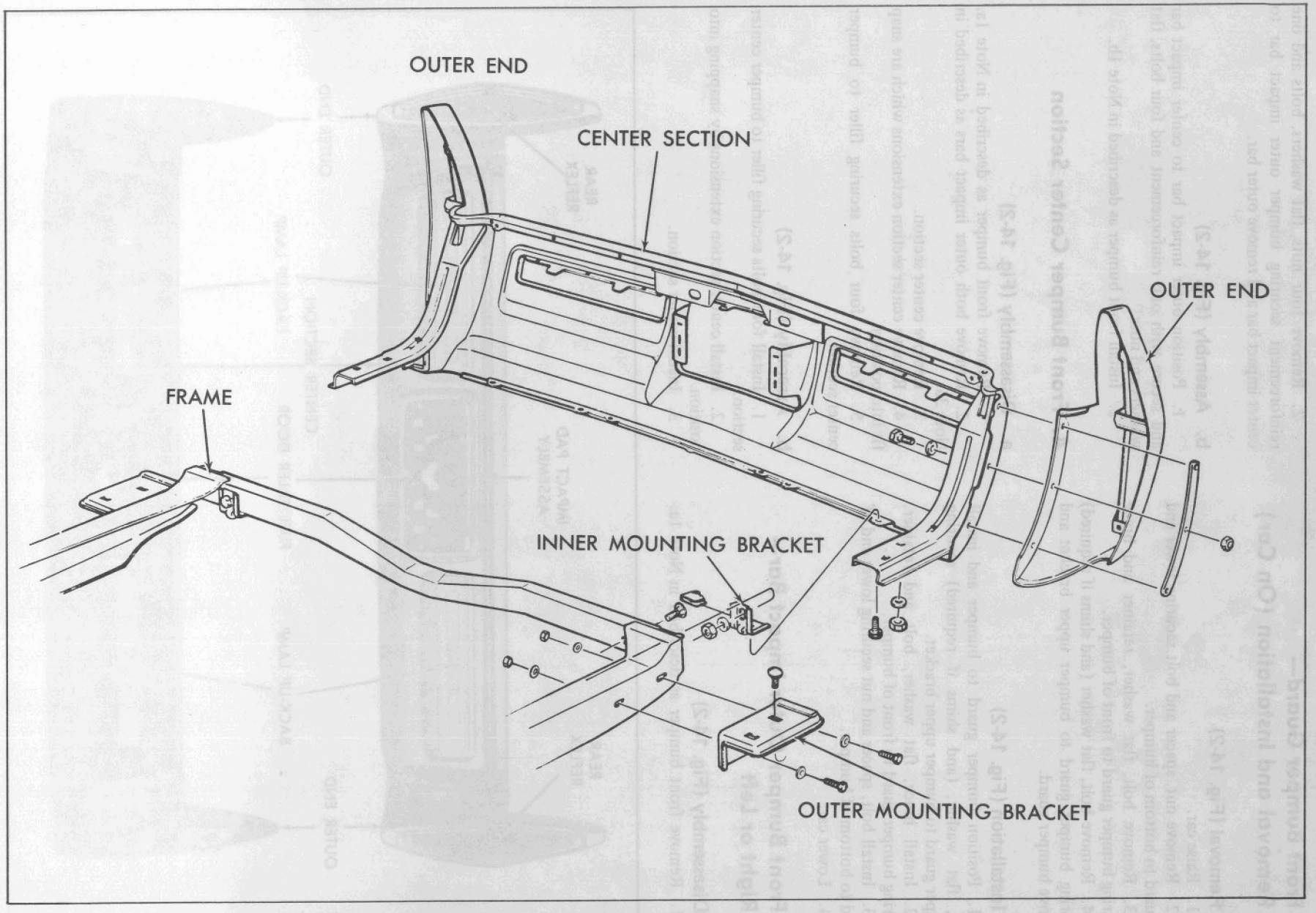


Fig. 14-4 Rear Bumper—Disassembled

4. Install both outer impact bars as described in Note 3b.
5. Install front bumper as described in Note 1b.

5. Rear Bumper Assembly

a. Removal (Fig. 14-4)

1. Open rear compartment lid.
2. Raise car.
3. Place hydraulic jack under bumper assembly.
4. Remove two nuts, flat washers, and forward bolt on outer frame mounting brackets.
5. Remove one bolt, each side, securing bumper to frame inner mounting bracket.
6. Working inside trunk, remove one nut, flat washer, and rubber cushion each side from bumper end.
7. Pull bumper down and rearward and remove rear bolt to frame.
8. Disconnect tail lamp, lamp monitor on cars so equipped, and gas tank wiring connectors from body end panel.
9. Remove bumper from car.

b. Installation (Fig. 14-4)

1. Place bumper on jack and position at car.
2. Connect tail lamp, lamp monitor on cars so equipped and gas tank wiring connectors to body end panel connectors.
3. Install rear bolt to frame.
4. Working inside trunk, install rubber cushion, lock washer and nut loosely at top of bumper ends.
5. Install forward bolt, flat washers and nuts securing bumper outer mounting brackets to frame.
6. Install one bolt, each side, securing bumper to frame inner mounting brackets to frame.
7. Align bumper to correct position and tighten all fasteners.
8. Remove bumper supporting jack.
9. Lower car.
10. Close rear compartment lid.

6. Rear Bumper Outer End—Right or Left

(NOTE: Rear reflex removal and installation is covered in Section 12, Note 8.)

a. Disassembly (Fig. 14-4)

1. Remove rear bumper assembly as described in Note 5a.
2. Disconnect tail lamp wiring connector from lamps.
3. Remove three nuts, bolts, six flat washers and one reinforcement securing bumper outer end to center impact bar and remove outer end.
4. Remove tail lamps as described in Section 12, Note 8a.

b. Assembly (Fig. 14-4)

1. Install tail lamps as described in Section 12, Note 8b.
2. Position rear bumper outer end to center impact bar and secure with three bolts, nuts, six flat washers and one reinforcement.
3. Connect tail lamp wiring connector to lamps.
4. Install rear bumper as described in Note 5b.

7. Rear Bumper Center Section

a. Disassembly (Fig. 14-4)

1. Remove rear bumper assembly as described in Note 5a.
2. Remove both outer ends as described in Note 6a.
3. Remove fuel tank filler door as described in Note 9a.
4. Remove two screws that secure license lamp housing to center section.
5. Remove back-up lamp as described in Section 12, Note 10a.
6. Remove 11 straps that secure wiring harness to center section.

b. Assembly (Fig. 14-4)

1. Install 11 straps that secure wiring harness to center section.
2. Install back-up lamp as described in Section 12, Note 10b.
3. Install two screws to secure license lamp housing to center section.
4. Install fuel tank filler door as described in Note 9b.
5. Install both outer ends as described in Note 6b.
6. Install rear bumper assembly as described in Note 5b.

8. Back-Up Light Housing Bezel—Right or Left (Except 693)

a. Removal (Fig. 14-4)

1. Remove three screws securing bezel to bumper.
2. Remove bezel.

b. Installation (Fig. 14-4)

1. Position bezel in bumper.
2. Install three screws securing bezel to bumper.

9. Fuel Tank Filler Door

a. Removal (Fig. 14-4)

1. Holding filler door in the open position, release spring tension by pushing down on door end of springs and disconnect springs from filler door and mounting brackets.
2. Pull door rearward, disengage pivot pins and remove door.

b. Installation (Fig. 14-4)

1. Pass filler door up between bumper and frame and into open position. Engage filler door pins into mounting brackets.
2. Engage door pivot springs in mounting brackets. Push other end toward filler door tensioning springs and engage in door.

TORQUE SPECIFICATIONS (EXCEPT ELDORADO)

Material Number	Application	Size	Foot Pounds
280M	Front Bumper Mounting Bar to Frame	1/2-20	50
280M	Rear Bumper Mounting Bar to Frame	1/2-20	50
280M	Front or Rear Bumper Mounting Bar to Bumper	1/2-20	45

NOTE: Refer to back of Manual, Page 16-1 for bolt and nut markings, and steel classifications.

ELDORADO BUMPERS

GENERAL DESCRIPTION

The front bumper assembly for the 1972 Eldorado, Fig. 14-5, is of seven-piece construction that includes a center section with removable bumper guards, intermediate sections and outer impact bars.

The rear bumper assembly, Fig. 14-7, consists of a center impact bar and outer ends incorporating integral taillight assemblies. The center bar incorporates a fuel filler door and also provides for the mounting of the license plate lamp and back-up lights.

Front and rear bumpers are equipped with impact pad assemblies.

SERVICE INFORMATION

10. Front Bumper Assembly

a. Removal (Fig. 14-5)

1. Raise front end of car.
2. Scribe marks on frame around mounting brackets to enable proper alignment during installation.
3. Remove two retaining nails securing center air deflectors (acromat) to mounting brackets.
4. Remove ten bracket-to-frame nuts and washers. Leave two outer bolts in to support bumper and remove remaining eight bolts.

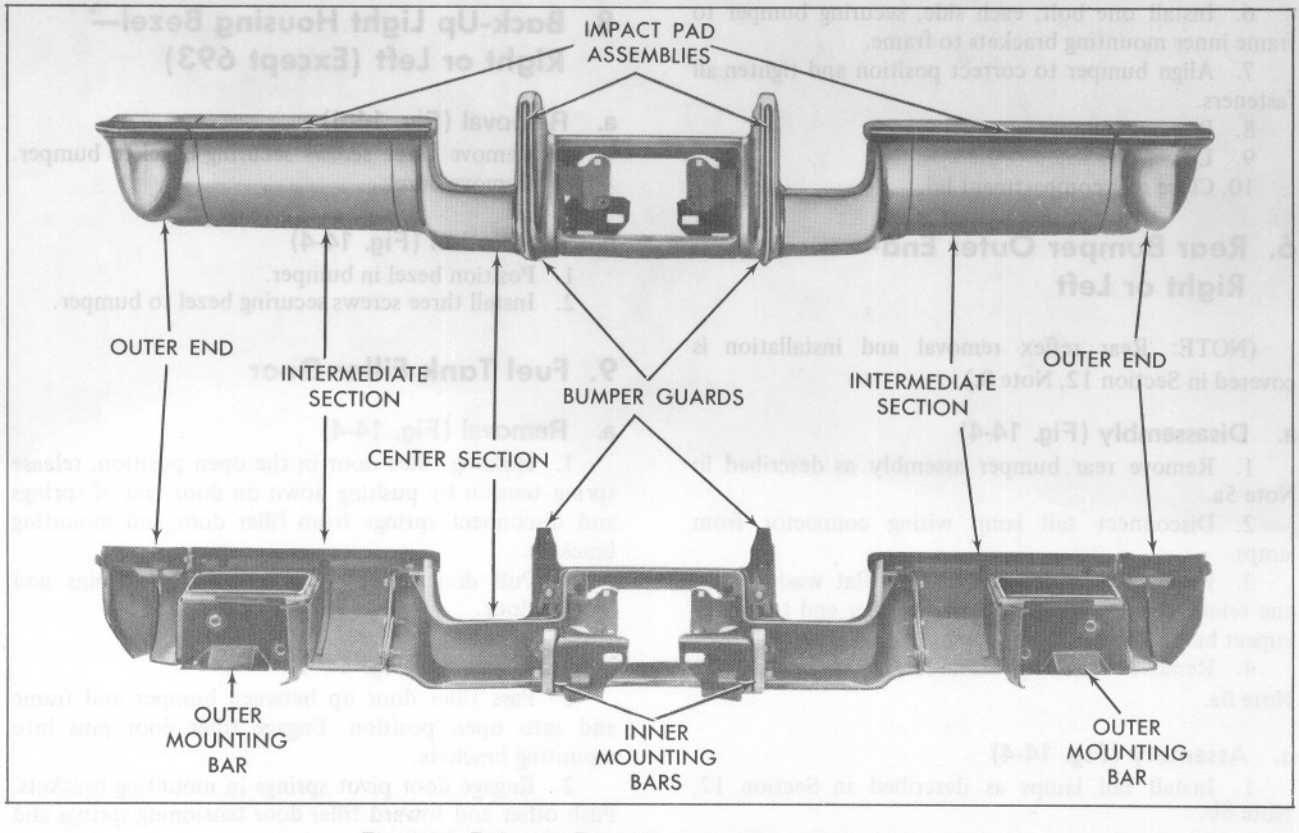


Fig. 14-5 Eldorado Front Bumper—Front & Rear View

5. Place hydraulic jack under bumper center section and lift bumper until remaining two bolts can be removed.
6. Remove bolts and lower bumper from car.

b. Installation (Fig. 14-5)

1. Place bumper on hydraulic jack and lift bumper to on-car position using alignment marks made during removal.
2. Install ten bolts, washers, and nuts and tighten. Proper alignment should be observed while tightening nuts.
3. Install two retaining nails securing center air deflectors to mounting brackets.
4. Remove jack and lower car.

11. Front Bumper

a. Disassembly (Fig. 14-6)

1. Remove bumper as described in Note 10a.
2. Remove three nuts and washers securing pad assembly to outer bumper section.
3. Remove three nuts, bolts, and six washers securing outer bumper section to intermediate section and remove outer section.
4. Remove four nuts, bolts, six washers and support plate securing intermediate section to center section and remove intermediate section.
5. Remove two nuts, two washers and carriage bolts securing center mounting bracket to bumper.
6. Remove remaining carriage bolt securing bumper guard to bumper.

b. Assembly (Fig. 14-6)

1. Position intermediate section on center section and align support plate.
2. Install four bolts, nuts and six washers and tighten.

(NOTE: Upper attaching bolt must be torqued first to assure proper alignment between sections.)

3. Align guard on bumper center section and position mounting bracket on carriage bolt.
4. Insert carriage bolts from front and underside of bumper.
5. Install washers and nuts on carriage bolts and tighten.
6. Position bumper outer section on intermediate section and install three bolts, nuts and six washers and tighten.
7. Install three washers and nuts securing impact pad assembly to bumper outer section.
8. Install bumper as described in Note 10b.

12. Front Bumper Intermediate Bar and Outer Bar Assembly—Right or Left (On Car)

a. Removal (Fig. 14-6)

1. Raise front end of car.
2. Remove four nuts flat washers, bolts and reinforcement, securing intermediate bar to center bar.

(NOTE: Upper bolt is removed with intermediate bar.)

3. Remove two nuts, flat washers and bolts securing mounting bar to frame at outer ends.
4. Remove intermediate bar and outer end as an assembly and lay face down on a covered surface.
5. Remove outer end as described in Note 11a, Step 2, and Step 3.

b. Installation (Fig. 14-6)

1. Install outer end as described in Note 11b, Step 6, and Step 7.
2. Install assembly with upper mounting bolt in position.
3. Loosely install two bolts, flat washers, and nuts to secure mounting bar to frame at outer ends.
4. Install reinforcement, bolts, flat washers, and four nuts.
5. Tighten bolts at mounting bar.
6. Lower front end of car.

13. Front Bumper Center Section

a. Disassembly (Fig. 14-6)

1. Remove front bumper assembly as described in Note 10a.
2. Remove outer and intermediate sections and bumper guards as described in Note 11a.

b. Assembly (Fig. 14-6)

1. Install outer and intermediate sections and bumper guards as described in Note 11b.
2. Install front bumper assembly as described in Note 10b.

14. Front Bumper Guard—Removal and Installation (On Car)

a. Removal (Fig. 14-6)

1. Raise car.
2. Remove nut, flat washer and bolt securing lower end of guard to bottom of bumper.
3. Remove nut, flat washers and brace securing bumper guard to front of bumper.
4. Remove bolt and flat washers securing bumper guard to bumper upper bracket and remove bumper guard.

b. Installation (Fig. 14-6)

1. Position bumper guard to bumper and install bolt and flat washers securing bumper guard to bumper upper bracket.
2. Install brace, flat washer and nut securing bumper guard to front of bumper.
3. Install bolt, flat washer and nut securing lower end of guard to bottom of bumper.
4. Lower car.

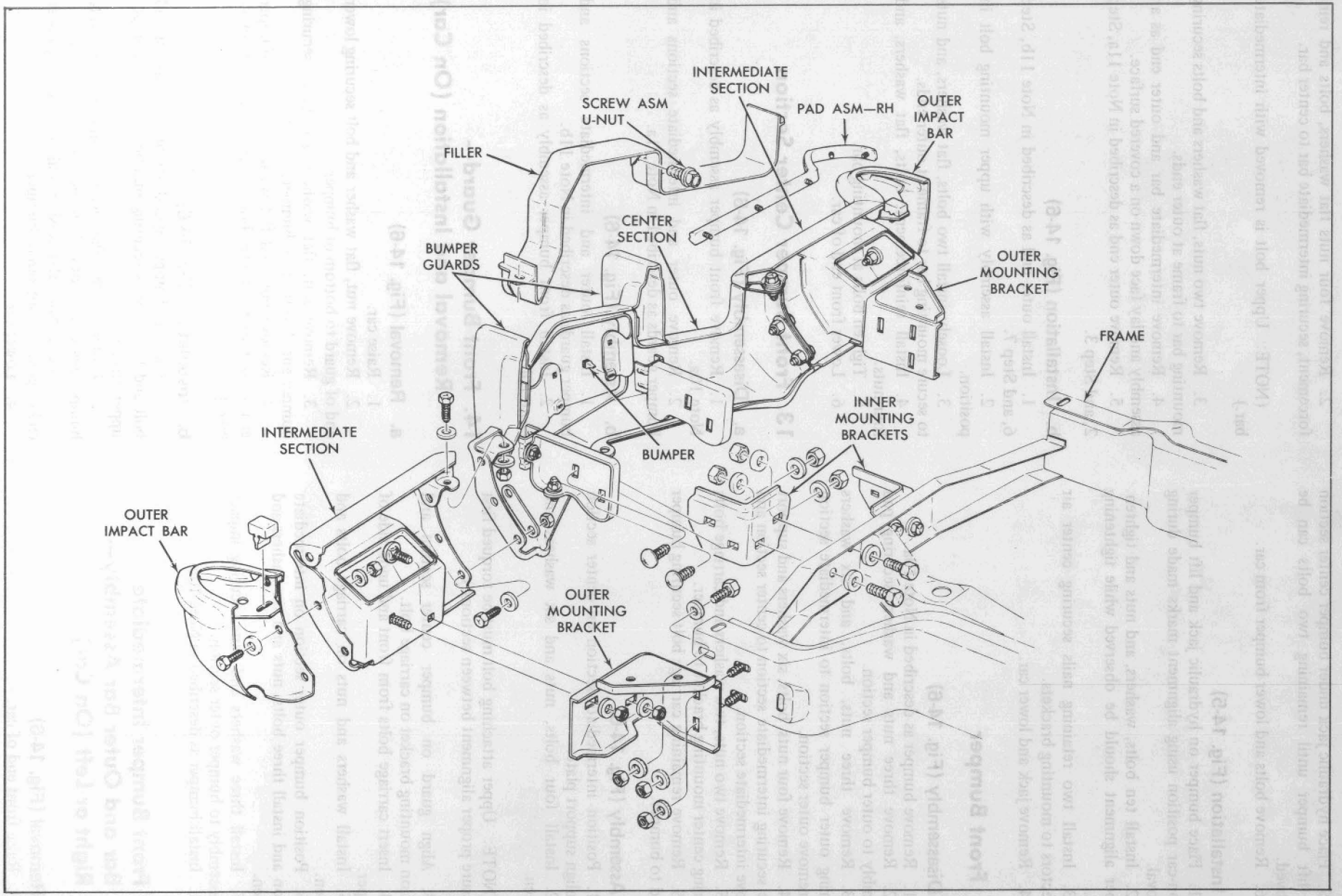


Fig. 14-6 Eldorado Front Bumper—Disassembled

15. Rear Bumper Assembly

a. Removal (Fig. 14-7)

1. Open rear luggage compartment.
2. Raise rear end of car.
3. Position a hydraulic jack to support bumper assembly.
4. Through license opening, disconnect bumper wiring harness connector from body end panel connector.

(NOTE: If car is equipped with lamp monitor system, there will be a wire connector at each lamp assembly that must be disconnected before bumper can be completely removed.)

5. Remove two bolts, flat washers and nuts on both sides securing lower mounting bracket to frame.
6. Remove luggage compartment trim.
7. Through rear end panel inside luggage compartment, remove nut, flat washer and rubber cushion, both sides securing upper outer end bar to body.
8. Remove bumper assembly by pulling rearward.

b. Installation (Fig. 14-7)

1. Raise bumper assembly to approximate car position.

(NOTE: If car is equipped with lamp monitor system, connectors should be installed at this point.)

2. Install bumper wiring harness to body end panel connector.
3. Install rubber cushion, flat washer and nut on both sides securing upper outer end bar to body.
4. Install two bolts, flat washers, and nuts, both sides securing lower mounting bracket to frame.
5. Remove jack and lower rear end of car.
6. Install luggage compartment trim and close compartment lid.

16. Rear Bumper Outer End—Right or Left

a. Disassembly (Fig. 14-8)

1. Remove rear bumper assembly as described in Note 15a.
2. Lay bumper assembly face down on a covered surface with a block supporting center section at end being removed.
3. Disconnect wiring connectors at lamp assembly.
4. Remove three bolts, washers, support and tapping plate securing outer end to center impact bar and remove outer end.

b. Assembly (Fig. 14-8)

1. Position bumper end to center impact bar and secure with three bolts, washers, support and tapping plate.
2. Connect wiring harness connectors to lamp assembly.
3. Install rear bumper as described in Note 15b.

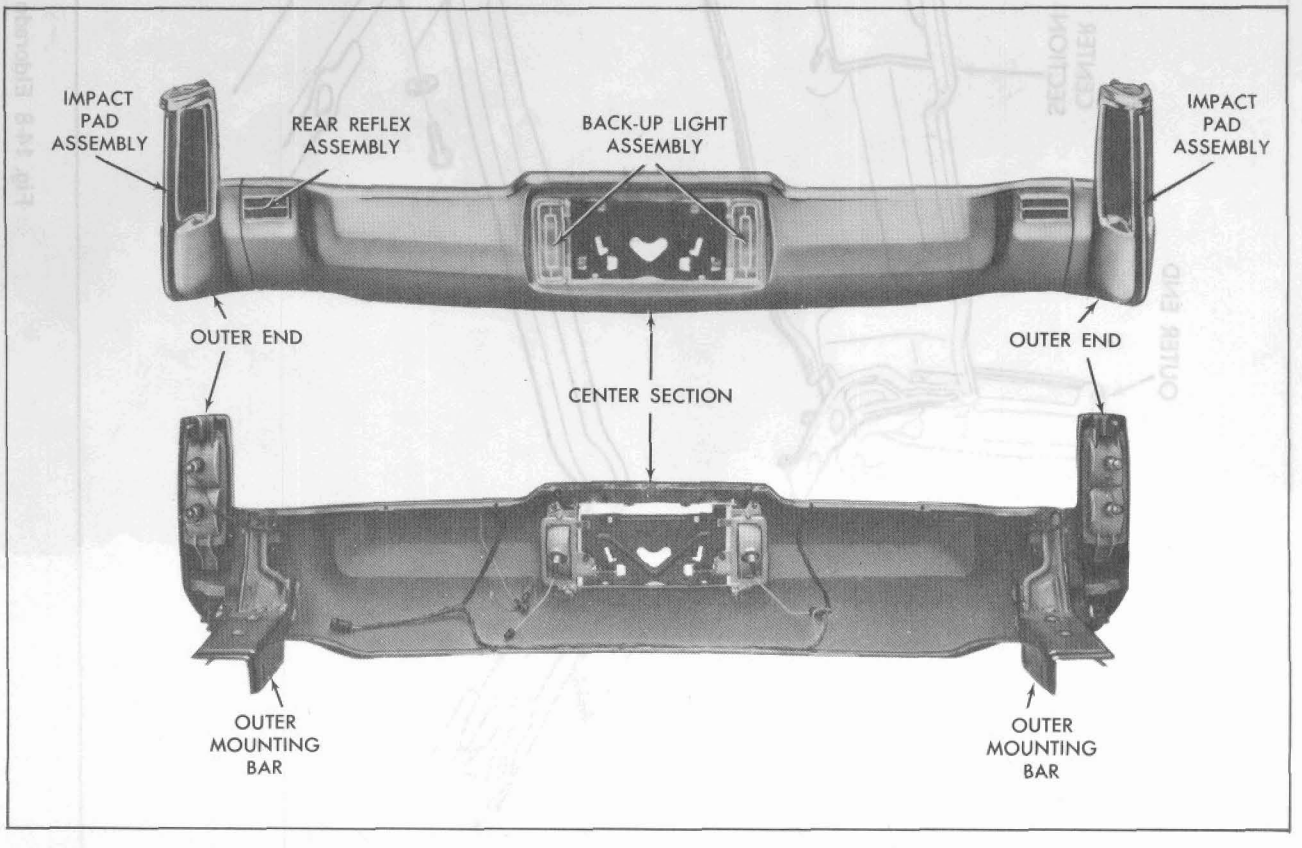


Fig. 14-7 Eldorado Rear Bumper—Front & Rear View

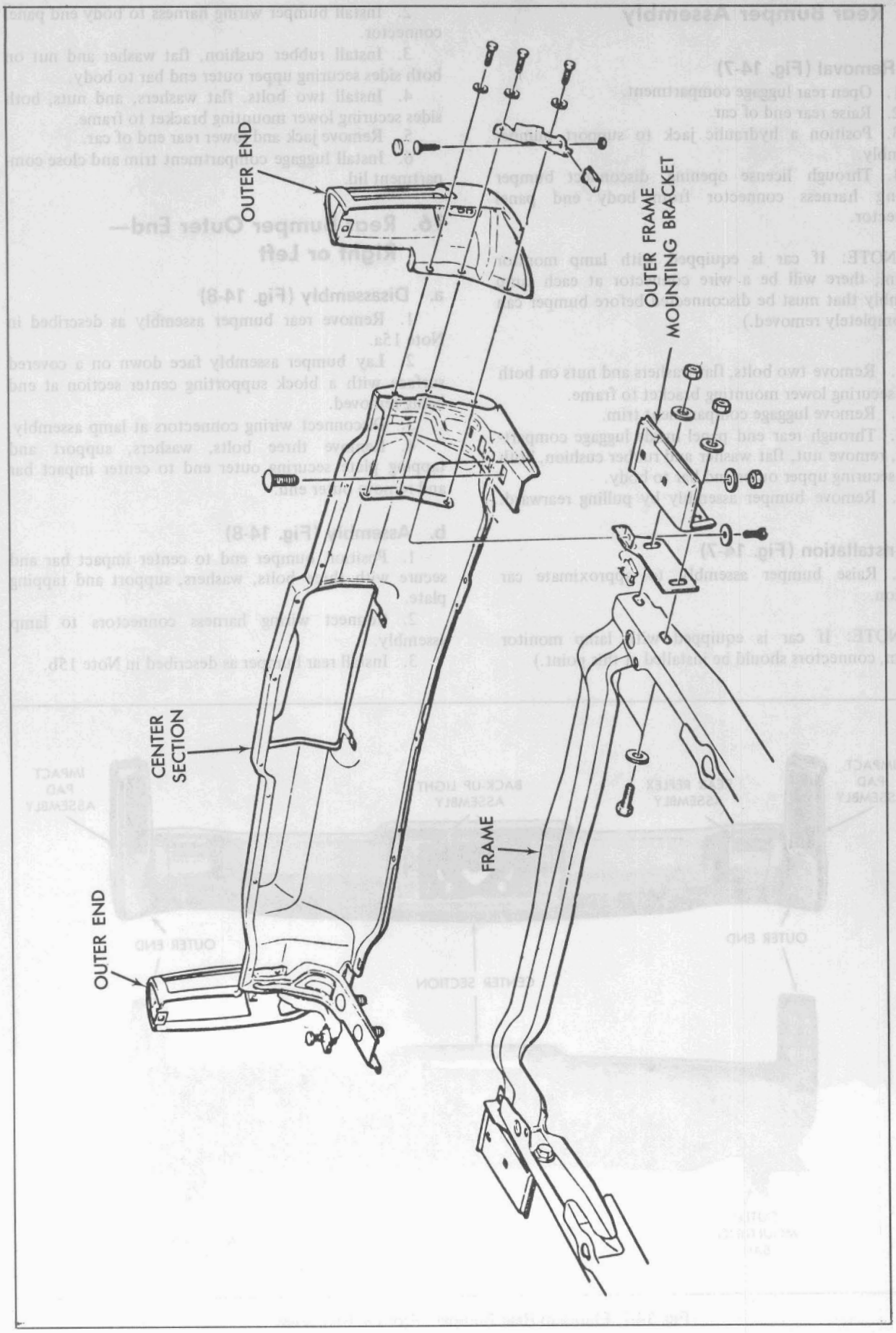


Fig. 14-8 Eldorado Rear Bumper—Disassembled

17. Rear Bumper Center Section

a. Disassembly (Fig. 14-8)

1. Remove bumper assembly as described in Note 15a.
2. Remove both outer ends as described in Note 16a.
3. Remove fuel filler door as described in Note 9a.
4. Remove wiring harness.
5. Remove two screws each side securing rear reflex bezel and lens and remove reflex.
6. Remove two screws securing license plate lamp and remove lamp.
7. Remove back-up lamps as described in Section 12, Note 17a.

b. Assembly (Fig. 14-8)

1. Install back-up lamps as described in Section 12, Note 17b.
2. Install reflex bezel and lens and secure with nuts.
3. Install license plate lamp and secure with two screws.
4. Install wiring harness.
5. Install fuel filler door as described in Note 9b.
6. Install both outer ends as described in Note 16b.
7. Install bumper as described in Note 15b.

18. Rear Reflex Bezel (693)

a. Removal (Fig. 14-8)

1. Open rear compartment.
2. Working between bumper and filler panel, remove two nuts securing bezel to bumper.
3. Remove bezel from opening in bumper.

b. Installation (Fig. 14-8)

1. Install bezel in bumper.
2. Working between bumper and filler panel, install two nuts securing bezel to bumper.
3. Close rear compartment.

TORQUE SPECIFICATIONS (ELDORADO)

Material Number	Application	Size	Foot Pounds
280M	Front Bumper Mounting Bar to Frame	1/2-20	50
280M	Rear Bumper Mounting Bar to Frame	1/2-20	50
280M	Front or Rear Bumper Mounting Bar to Bumper	1/2-20	45
NOTE: Refer to back of Manual, Page 16-1, for bolt and nut markings, and steel classifications.			





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RADIO AND ANTENNA
THEORY OF OPERATION

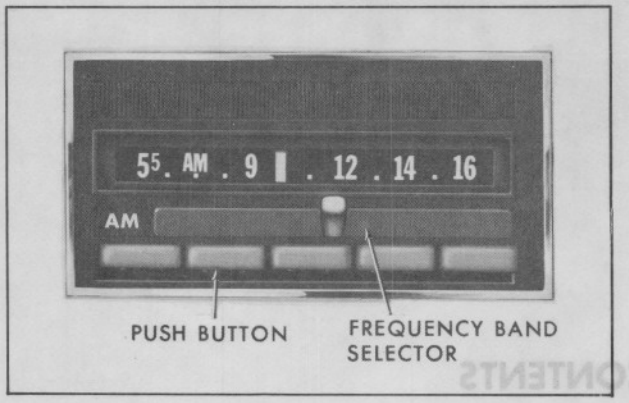


Fig. 15-1 AM/FM Pushbutton Receiver

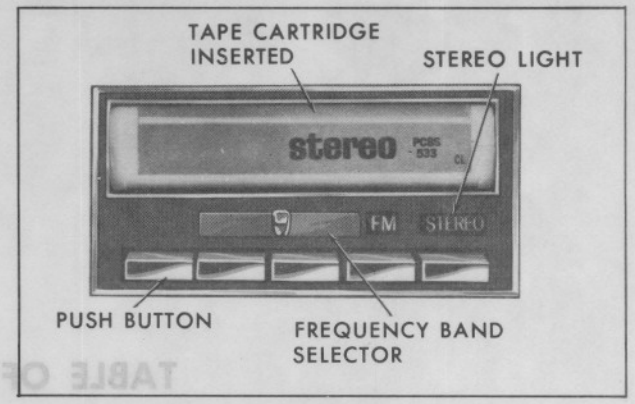


Fig. 15-3 AM/FM Stereo Eight Track Tape

The radio options for 1972 include an AM/FM pushbutton radio, Fig. 15-1; an AM/FM pushbutton stereo signal seeking radio, Fig. 15-2; an AM/FM pushbutton stereo radio with an integral eight-track tape player, Fig. 15-3; and for 697 styles, an AM/FM pushbutton stereo radio with signal seeking and rear remote radio controls. The radio receiver unit is located in the instrument panel to the right of the steering column. The AM/FM push button radio consists of a receiver unit and three separate speaker units. The stereo radios consist of a receiver unit and four separate speaker units.

There are two 3-1/2 inch round front speakers, one at each end of the upper instrument panel cover, on all radio installations. Two 6 inch x 9 inch rear speakers, one at each end of the rear filler panel, are used on all stereo installations except convertibles. On convertibles, the rear stereo speakers are mounted behind the rear seat in the well for the convertible top. On convertibles with an AM/FM radio, the rear speaker is mounted in the right side of the convertible top well.

On stereo installations, the left front and right rear speakers are on one channel and the right front and left rear speakers are on another channel.

All receivers are equipped with a frequency band selector bar. Moving the band selector bar to the left, rotates the dial to engage the FM band and all preset FM stations. Conversely, moving the selector bar to the right engages the AM band. Any preset station is mechanically tuned in by depressing the appropriate pushbutton located directly below the band selector bar.

A concealed windshield antenna is used for all radio installations. The antenna is composed of two lengths of .005 inch diameter wire imbedded in the laminate between the windshield glasses. The wires run up the center of the windshield to the top, then in opposite directions along the top, Fig. 15-4. An antenna pigtail is bonded to the lower center of the windshield. The antenna pigtail connects to the antenna lead-in cable mounted to the cowl plenum chamber, Fig. 15-4, connecting the antenna to the radio.

AM/FM and AM/FM Stereo Radio

The AM/FM and AM/FM Stereo radios have advantages and limitations that must be explained to owners who are not familiar with the operations of FM units.

The frequencies (88-108MHZ) at which FM stations operate create much shorter radio wave lengths than those produced in AM broadcasting. Unlike AM signals, FM signals do not bend around the horizon. This limits the distance at which FM signals can be received. The dependable range of FM reception in an automobile is a

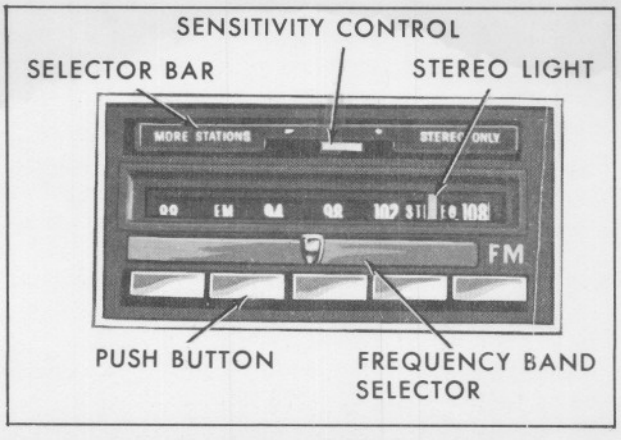


Fig. 15-2 AM/FM Signal Seeking Stereo

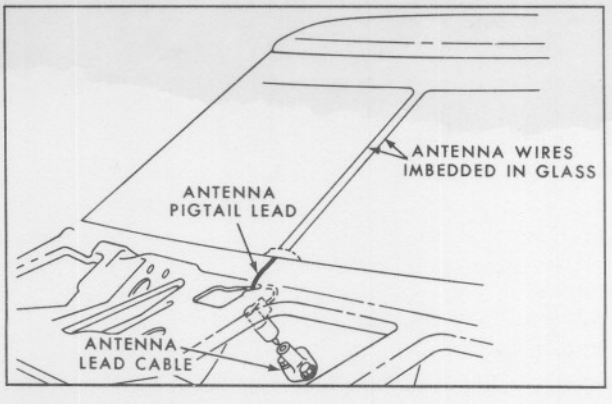


Fig. 15-4 Windshield Antenna

radius of approximately twenty miles from the transmitting antenna.

When the FM receiver moves out of range of the FM transmitter, it enters what is referred to as the fringe area. In the fringe area, the strength of the FM signal may vary rapidly, causing a flutter or a series of noise bursts as the car moves between high and low level signal points.

A second effect found in the fringe area is the presence of ignition interference from adjacent vehicles. In both instances, it may be possible to improve reception by retuning; however, it may be necessary to change to a different station if reception still is not good.

Retuning should be necessary only in those few instances when reception becomes slightly noisy while driving through areas such as the center of a large city and a weak signal is being received from a station located away from the center of the city. The interference can be quieted by adjusting the tone control for more bass, and by shifting the speaker fader to favor the rear seat.

While these adjustments will slightly diminish stereo effect on cars so equipped, they will substantially reduce background noise interference.

As soon as reception clears, reset the tone control to the normal detent and again adjust the front and rear speakers for equal output.

The FM section of the AM/FM and AM/FM Stereo radios is equipped with automatic frequency control, which aids tuning to a station. The FM receiver should be tuned directly on station frequency for minimum noise interference; however, the automatic frequency control will tune directly to and lock on station frequency when slight mistuning is encountered.

Another feature of FM tuning is signal separation. When two FM stations are close in frequency, the FM tuner selects the stronger signal, rejecting the weaker one. This is in contrast to AM performance, where it is not always possible to separate two stations.

The AM/FM radio incorporates an AM receiving circuit and an FM receiving circuit. The audio system is common to both receiving circuits.

The AM/FM Stereo radio incorporates an AM receiving circuit, an FM receiving circuit, an FM stereo detection circuit, and a dual channel audio amplifier in one unit.

The signal seeking feature is provided on the AM/FM Stereo radio. The AM and FM frequency band selector bar is located below the receiver dial.

AM/FM Stereo radios should always be fine tuned to assure maximum signal response and minimize unwanted noise.

To simplify tuning, only the dial for the frequency band selected is visible. The letters "AM" or "FM" on either side of the selector bar show the frequency band selected.

On stereo radios, the letters "STEREO" on the right side of the dial illuminate as shown in Fig. 15-2 when the FM station tuned is capable of transmitting stereo. The illumination of the letters "STEREO", however, does not indicate that the station is transmitting stereo at the particular moment. Stereo programs are broadcast on the FM frequency band only.

AM/FM Stereo Radio and Eight Track Tape Player

With the AM/FM stereo radio and eight-track tape player, the owner may make his own selection of prerecorded music. To operate in the tape player mode, turn the radio on and fully insert a tape cartridge into the opening behind the face of the receiver dial. The dial face will swing up into the receiver, similar to a mail chute door, when the tape cartridge is inserted. This automatically removes power from the radio and switches control of the speakers to the tape player.

To change tape programs, momentarily depress the volume control knob. Each time the volume control knob is depressed, the tape cartridge will change to the next recorded program. To eject the tape cartridge from the engaged position, gently pull out on the volume control knob. The cartridge may be left in this ejected position without damage to the tape. With the tape cartridge ejected, power is automatically returned to the radio along with control of the speakers. To fully remove the tape cartridge, pull gently out of the radio face.

Tape cartridges should be handled carefully and should be kept clean. A cartridge should not be left inserted fully in the player. This may cause permanent damage to the cartridge.

Signal Seeking Tuner

The signal seeking tuner provided on AM/FM Stereo radios is electronically controlled so that the operator may change stations by depressing the selector bar. The signal seeking operation consists of a low to high frequency sweep (left to right) of the AM or FM broadcast band by the tuner.

When the selector bar is depressed and released, the tuner moves to the station of next higher frequency (to the right) and stops automatically at the point where that station is best received. This action takes place each time the selector bar is depressed. When the tuner has reached the point of highest frequency of the broadcast band, it returns to the low frequency (left) side of the broadcast band and begins a new sweep to the right, stopping at the first receivable station. The above procedure is then repeated when the bar is again depressed.

The stopping sensitivity of the signal seeking tuner may be varied by changing the position of the three-position sensitivity control switch located just below the center of the selector bar, Fig. 15-2. The third (right hand) position allows the signal seeking tuner to stop only on FM stereo stations when the radio is being played on the FM frequency band.

A foot control switch that performs the same station seeking functions as the station selector bar is available as a dealer installation for signal seeking radios only.

The circuit diagram for radios is illustrated in Fig. 15-5.

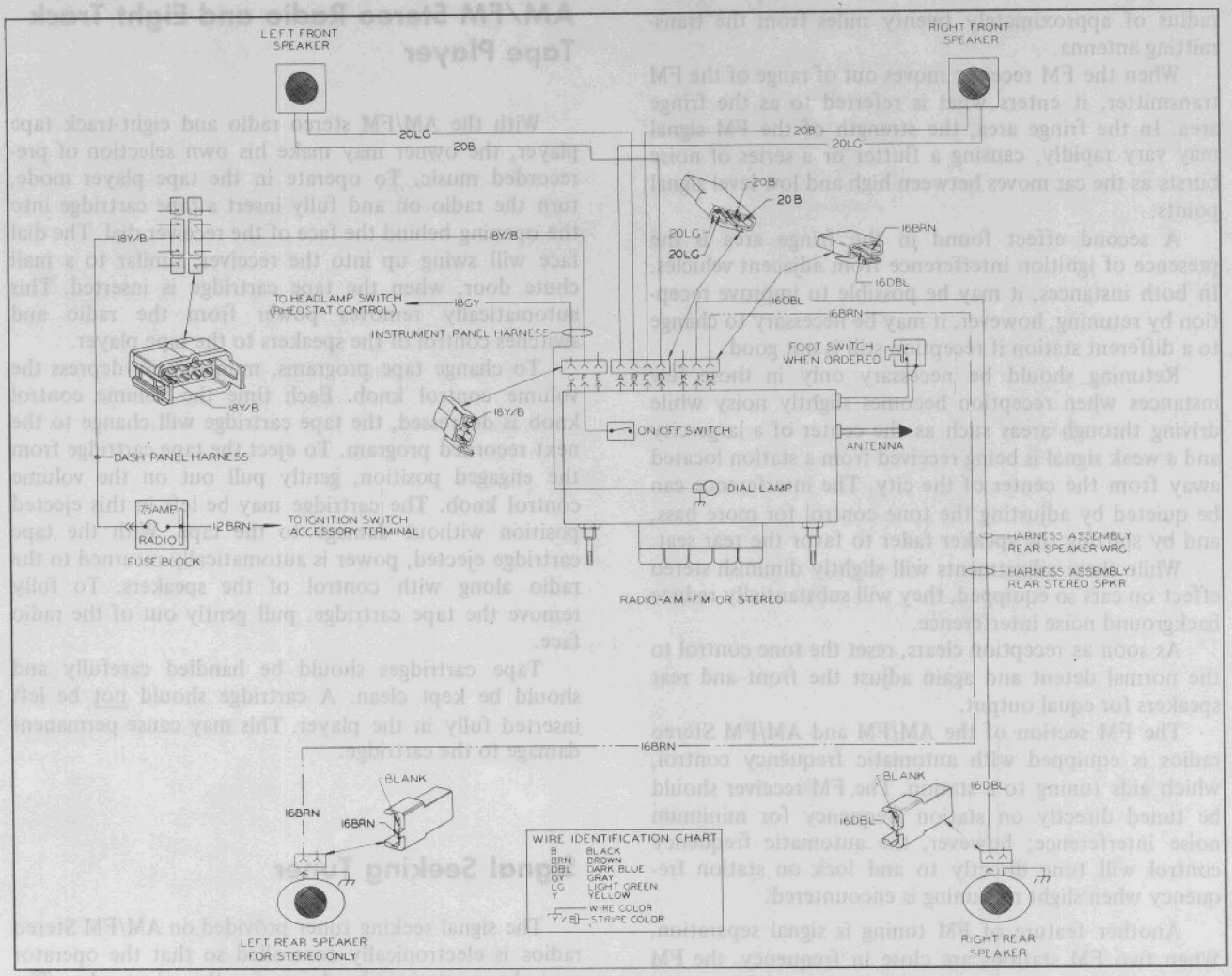


Fig. 15-5 Radio Circuit Diagram

1. Radio Controls, Operation

a. Frequency Band Selector Bar

The frequency band selector bar is located below the frequency dial. Sliding the bar to the right engages the AM band, rotates the dial to the AM frequency, and illuminates the "AM" tell-tale light located at the left side of the dial. Sliding the selector bar to the left engages the FM band, rotates the dial to the "FM" frequency, and illuminates the "FM" tell-tale light located at the left side of the dial. Stereo broadcasts can be received on the FM band only. When an FM stereo station is tuned, the "Stereo" tell-tale light to the right of the dial illuminates.

On the stereo radio with the tape player, the "Stereo" light is located to the right of the band selector.

b. Rear Seat Remote Control (697 Styles Only)

Rear seat remote radio control is available as an option for installation in 697 style cars equipped with the AM/FM stereo signal seeking radio. The remote controls consist of an ON-OFF volume control, a sensitivity control, and a selector button located behind the sliding access door in the right rear quarter panel trim.

Once the appropriate AM or FM band is selected at the radio, the rear seat remote control overrides the front radio control when it is turned on. The ON-OFF volume control knob turns the radio on and off, and controls the volume in both channels simultaneously. The three position sensitivity control is located beneath the ON-OFF volume control knob. Rotating the control clockwise when the receiver is on the AM band allows the tuner to stop only on most powerful stations, slightly lower power stations, and all possible stations respectively. Rotating the control clockwise when the receiver is on the FM band allows the tuner to stop only on the most powerful stations, all possible stations, and stereo-only stations respectively.

c. Switch Volume and Tone Controls

The left knob turns the radio on and off, and controls the volume. On the stereo radio, the knob controls the volume in both channels simultaneously. The tone control ring around the left knob is turned counterclockwise for bass tones and clockwise for treble tones.

When indexed at the detent, it provides a balanced normal tone. On the stereo radio, this control varies the tone in both channels simultaneously. On the radio with stereo eight-track tape player combination, momentarily depressing the volume control knob changes tape programs, with a cartridge fully inserted. Pulling gently on the volume control knob ejects the tape cartridge.

For best stereo reception, neutralize the tone control by turning it to the center detent position, then adjust the front and rear speaker control as outlined in Part d of this note so that the sound is balanced to your ears. Centering the tone control permits normal response from the speakers, and balanced speaker output is desirable for greatest stereo effect.

d. Manual Station Selector and Speaker Control

The right knob is used to tune stations manually. The ring around the knob is the speaker control. When the ring is turned all the way counterclockwise on the monaural, about 90% of the volume will be shifted to the front speakers. Turning the ring progressively clockwise will shift the speaker favor to the rear. Turning the ring to the full clockwise position shifts about 90% of the speaker volume to the rear speaker or speakers. This control has no effect on the balance of stereo channels.

e. Push Button Tuning (AM/FM or AM/FM Stereo Radios)

Each one of the five push buttons may be preset to a favorite AM station when on the AM band. Each one of these same five push buttons may be set to a favorite FM or stereo station when on the FM band. This makes a total of ten pre-set favorite stations. To preset push buttons on AM stations, proceed as follows:

Slide frequency band selector bar to the right to engage the AM band. Manually fine tune to favorite AM station. Pull push button straight out to unlatch then push in all the way to relatch. Push button is now set to desired station. Whenever this push button is depressed, the preset station will be selected. Set additional push buttons to AM stations as desired.

To preset push buttons to FM and FM stereo stations, proceed as follows:

Slide frequency band selector bar to the left to engage the FM band. Manually fine tune to favorite FM or stereo station. Pull push button straight out to unlatch. Then push in all the way to relatch. Push button is now set to desired FM or Stereo station. Whenever this push button is depressed, the preset station will be selected. Set additional push buttons to FM or stereo stations as desired.

CAUTION: Do not move the AM-FM slide bar band selector while any push button is pulled out.

f. Automatic Tuning (Signal Seeking Radios Only)

To use automatic tuning, depress the selector bar above the dial momentarily. Any station within range of the receiver and determined by the sensitivity control switch setting, can be obtained by holding the bar depressed until the dial pointer approaches the desired frequency, and then releasing the bar. The automatic tuner will seek immediately when the selector bar is depressed.

g. Sensitivity Control (Signal Seeking Radios Only)

A three-position sensitivity control switch for automatic tuning is located below the center of the selector bar. On the AM band, moving the switch to the left allows the tuner to stop only on most powerful stations. In the middle position, stations of slightly lower power will be received in addition to stronger stations. To obtain maximum sensitivity, and bring in all possible stations, move switch to the right.

On the FM band, the left and center switch positions allow the tuner to stop only on most powerful stations and all possible stations respectively.

When the switch is in the right hand position, the tuner will stop only on FM stereo stations.

On 697 series cars, when the rear seat remote radio controls are on, the red selector button is illuminated. Depressing this button performs the same function as pressing the selector bar. With the rear seat radio control ON, the driver may reduce or increase the volume of the front speakers with the ring behind the right control knob, tune the radio manually or with the push buttons, and change the frequency bands. With the ring around the left control knob, he may vary the tone in both channels simultaneously. With remote control turned OFF, all front controls will operate normally.

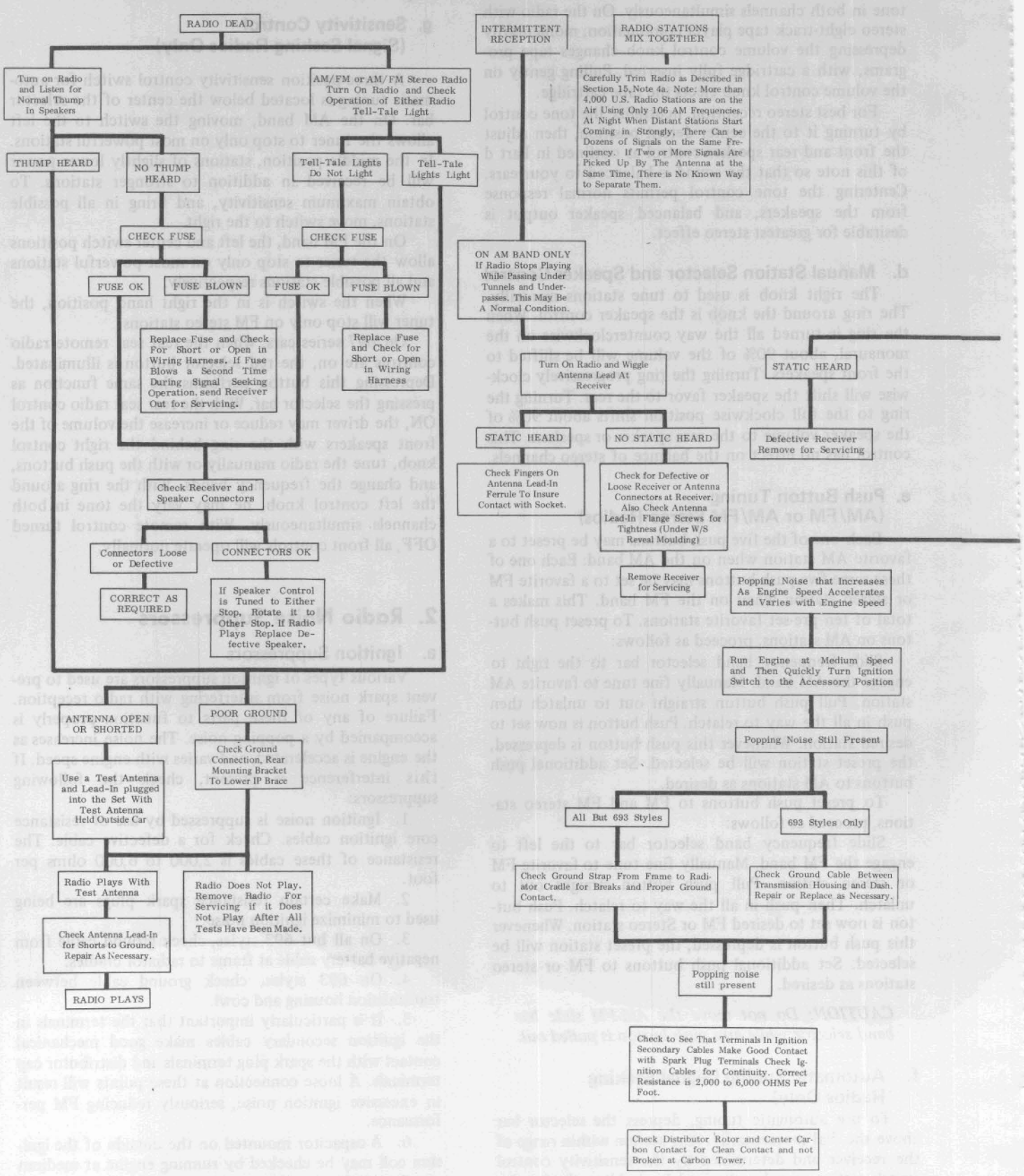
2. Radio Noise Suppressors

a. Ignition Suppressors

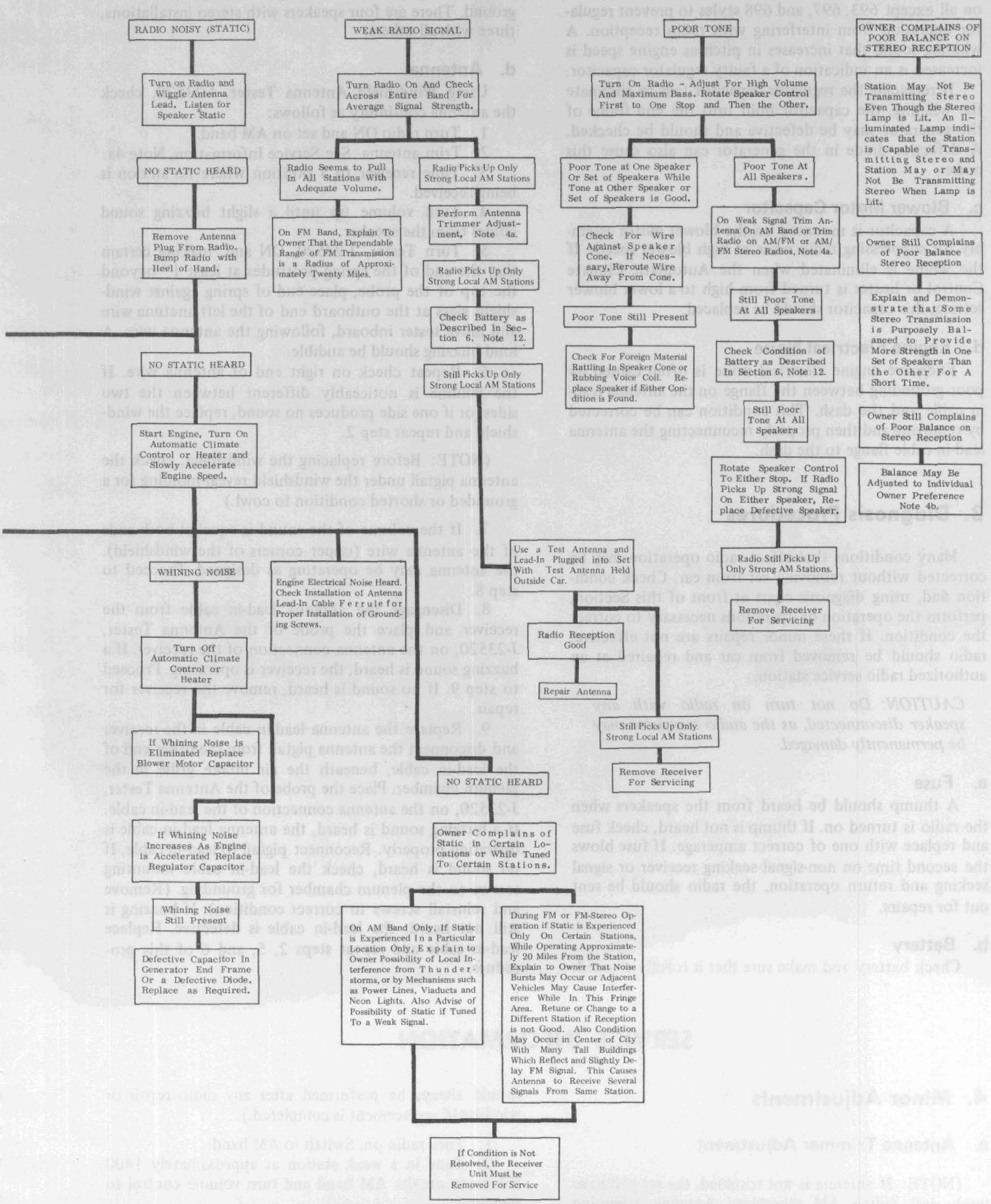
Various types of ignition suppressors are used to prevent spark noise from interfering with radio reception. Failure of any of these parts to function properly is accompanied by a popping noise. The noise increases as the engine is accelerated, and varies with engine speed. If this interference is present, check the following suppressors:

1. Ignition noise is suppressed by use of resistance core ignition cables. Check for a defective cable. The resistance of these cables is 2,000 to 6,000 ohms per foot.
2. Make certain resistance spark plugs are being used to minimize ignition noise.
3. On all but 693 styles, check ground cable from negative battery cable at frame to radiator cradles.
4. On 693 styles, check ground cable between transmission housing and cowl.
5. It is particularly important that the terminals in the ignition secondary cables make good mechanical contact with the spark plug terminals and distributor cap terminals. A loose connection at these points will result in excessive ignition noise, seriously reducing FM performance.
6. A capacitor mounted on the outside of the ignition coil may be checked by running engine at medium speed and then quickly turning ignition switch to the Accessory position. If the noise is eliminated, while the engine is coasting to a stop, replace faulty coil capacitor.

RADIO DIAGNOSIS CHART



RADIO DIAGNOSIS CHART



b. Regulator Capacitor

A capacitor is mounted on the generator regulator on all except 693, 697, and 698 styles to prevent regulator operation from interfering with radio reception. A whining sound that increases in pitch as engine speed is increased is an indication of a faulty regulator capacitor.

If replacing the regulator capacitor fails to eliminate the whining, the capacitor built into the end frame of the generator may be defective and should be checked. A defective diode in the generator can also cause this noise.

c. Blower Motor Capacitor

A capacitor is mounted on the blower motor assembly for suppressing radio noise at high blower speeds. If the whine is eliminated when the Automatic Climate Control or heater is turned from high to a lower blower setting, this capacitor should be replaced.

d. Engine Electrical Noise

Excessive engine electrical noise is often caused by poor grounding between the flange on the antenna lead-in cable and the dash. This condition can be corrected by removing and then properly reconnecting the antenna lead-in cable flange to the dash.

3. Diagnosis Procedures

Many conditions that affect radio operation may be corrected without removing set from car. Check condition and, using diagnosis chart at front of this Section, perform the operation or operations necessary to correct the condition. If these minor repairs are not effective, radio should be removed from car and repaired at an authorized radio service station.

CAUTION: Do not turn on radio with any speaker disconnected, as the audio transistor may be permanently damaged.

a. Fuse

A thump should be heard from the speakers when the radio is turned on. If thump is not heard, check fuse and replace with one of correct amperage. If fuse blows the second time on non-signal seeking receiver or signal seeking and return operation, the radio should be sent out for repairs.

b. Battery

Check battery and make sure that it is fully charged.

c. Speaker Connections

Check speaker leads for possible open circuit or ground. There are four speakers with stereo installations, three with all others.

d. Antenna

Using Windshield Antenna Tester, J-23520, check the antenna continuity as follows:

1. Turn radio ON and set on AM band.
2. Trim antenna. See Service Information, Note 4a.
3. Tune receiver to a position where no station is being received.
4. Turn volume up until a slight buzzing sound comes from the speaker.
5. Turn Tester, J-23520, ON and, making certain that the end of the spring protrudes at least 1" beyond the top of the probe, place end of spring against windshield glass at the outboard end of the left anetnna wire and move tester inboard, following the antenna wire. A loud buzzing should be audible.
6. Repeat check on right end of antenna wire. If the volume is noticeably different between the two sides, or if one side produces no sound, replace the windshield and repeat step 2.

(NOTE: Before replacing the windshield, check the antenna pigtail under the windshield reveal molding for a grounded or shorted condition to cowl.)

7. If the volume of the sound is equal at both ends of the antenna wire (upper corners of the windshield). the antenna may be operating as designed. Proceed to step 8.
8. Disengage the antenna lead-in cable from the receiver and place the probe of the Antenna Tester, J-23520, on the antenna connection of the receiver. If a buzzing sound is heard, the receiver is operating. Proceed to step 9. If no sound is heard, remove the receiver for repair.
9. Replace the antenna lead-in cable in the receiver and disconnect the antenna pigtail from the other end of the lead-in cable, beneath the air intake grille in the plenum chamber. Place the probe of the Antenna Tester, J-23520, on the antenna connection of the lead-in cable. If a buzzing sound is heard, the antenna lead-in cable is operating properly. Reconnect pigtail to lead-in cable. If no sound is heard, check the lead-in cable mounting screws to the plenum chamber for grounding. (Remove and reinstall screws to correct condition). If buzzing is still not heard, the lead-in cable is defective. Replace lead-in cable and repeat steps 2, 5, and 6 of this procedure.

SERVICE INFORMATION

4. Minor Adjustments

a. Antenna Trimmer Adjustment

(NOTE: If antenna is not trimmed, the set will have weak and fading AM reception. Antenna trimming should always be performed after any radio repair or windshield replacement is completed.)

1. Turn radio on. Switch to AM band.
2. Tune in a weak station at approximately 1400 Kilohertz on the AM band and turn volume control to maximum.

3. Adjust antenna trimmer, located behind right control knob and ring, for maximum volume. Access to antenna trimmer is gained by pulling off right control knob and ring and using a standard 1/8" screwdriver to adjust the screw, Fig. 15-6.

(NOTE: If, during adjustment, the station becomes strong, tune to a weaker station and continue the adjustment.)

4. After adjusting trimmer for best AM reception, check performance of FM band.

b. Balance Adjustment (AM/FM Stereo Models Only)

If the sound appears to be louder on one side of the car than the other, an adjustment to the audio balance may be made.

(NOTE: On some stereo programming, it is normal for one side to be louder than the other for a short time. This is done purposely for stereo effect. The only positive method to tell if the balance control needs adjustment is to tune in a non-stereo program and make a critical evaluation, in which the owner may assist.)

If adjustment is needed, proceed as follows:

1. Pull off left knob and ring to gain access to stereo balance screw.

2. With radio playing and fader control turned fully clockwise, insert screwdriver into balance control screw, Fig. 15-7. Rotate balance control adjustment clockwise or counterclockwise until the sound in the left and right speakers appears to have equal volume on a monaural AM station.

3. Install left ring and control knob.

5. Radio Receiver Unit

The procedure for removing and installing the radio receiver unit is described in Section 12, Note 57.

6. Radio Front Speaker

The procedure for removing and installing the radio front speakers is described in Section 12, Note 58.

7. Radio Rear Seat Speaker-Except Convertible

a. Removal

(NOTE: Access to rear speaker is gained through trunk compartment.)

1. Disconnect speaker lead (dark blue) from connector at rear of speaker. This is a brown lead on the AM/FM Stereo left rear speaker.

2. Remove four nuts securing speaker to rear filler panel and remove speaker.

b. Installation

1. Install speaker to rear filler panel and tighten four attaching nuts evenly to a maximum of 12 inch-pounds to prevent speaker distortion.

2. Connect speaker lead (dark blue) to connector at rear of speaker. This is a brown lead on the AM/FM Stereo left rear speaker.

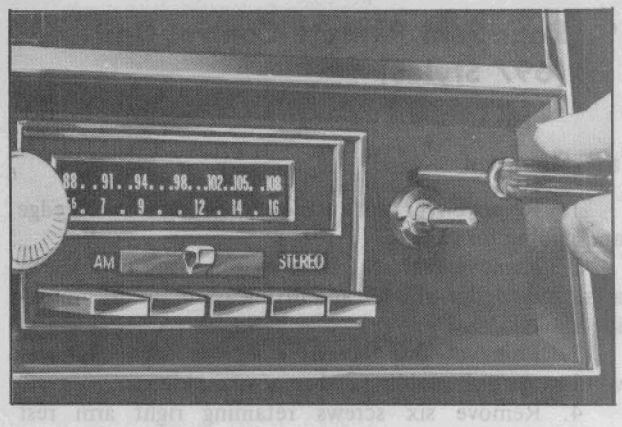


Fig. 15-6 Adjusting Antenna Trimmer

8. Radio Rear Seat Speaker—Convertible Only

a. Removal

1. Remove top well upper trim.

2. Remove four Phillips head attaching screws and remove grille.

3. Peel back top well canvas.

4. Remove four speaker enclosure mounting screws and screw securing black ground wire.

5. Disconnect speaker lead (dark blue on right side or brown on left side.)

6. Remove speaker assembly.

(NOTE: Convertibles without stereo use only a right rear speaker.)

b. Installation

1. Install four nuts securing speaker to enclosure.

2. Connect speaker lead (dark blue on right side or brown on left side).

3. Install screw securing black ground wire.

4. Position top well canvas.

5. Install grille with four Phillips head attaching screws.

6. Install top well upper trim.



Fig. 15-7 Stereo Balance Adjustment

9. Rear Seat Remote Control Unit (697 Styles)

a. Removal

1. Remove rear seat cushion by lifting forward edge and pulling forward.
2. Remove rear seat back by removing two screws along lower edge of back and lifting assembly off mounting hooks.
3. Remove five screws securing right quarter window garnish molding and remove molding.
4. Remove six screws retaining right arm rest assembly.
5. Remove right front and rear door sill plates.
6. Remove right front kickpad.
7. Peel back rug to gain access to remote cable along right sill, and remove securing tape.
8. Remove upper instrument panel top cover as described in Section 12, Note 40a.
9. Disconnect cable assemblies at rear of radio.
10. Remove one screw and bend two clips out of way and remove cable from shroud vent duct and hinge pillar areas.
11. Thread cable through harness conduit in rear partition.
12. Loosen set screw in knob assembly and remove knob assembly, felt washers, and sensitivity ring.
13. While holding control and cable assembly in one hand, remove jamb nut securing assembly to escutcheon.
14. Route cable out of right rear quarter trim panel assembly.

b. Installation

1. Thread plug end of cable forward through hole in line with harness conduit in rear partition.
2. Route cable to radio through hinge pillar area and along shroud vent duct.
3. Connect cable assemblies at left rear corner of radio.
4. Route cable along instrument panel and install in wiring conduit. Secure with one screw and two clips.
5. Secure control and cable assembly to escutcheon with jamb nut.
6. Install sensitivity ring, felt washer, and knob assembly and tighten set screw in knob assembly.
7. Install right front kickpad.
8. Install rug and right front and rear door sill plates.
9. Install instrument panel top cover as described in Section 12, Note 40b.
10. Install right armrest assembly with six attaching screws.
11. Install right quarter window garnish molding and secure with five screws.
12. Install rear seat back on mounting hooks and secure with two attaching screws.
13. Install rear seat cushion.
14. Turn on radio and test for operation. Peak antenna trimmer on weak station at approximately 1400 Kilohertz on AM band, as described in Note 4a.

CRUISE CONTROL THEORY OF OPERATION

Cruise Control is a speed control system that uses manifold vacuum to power the throttle servo unit. The servo moves the throttle when speed adjustment is necessary by receiving a varying amount of controlled vacuum from the transducer unit.

The speedometer cable from the transmission drives the transducer, and a cable from the transducer drives the speedometer. The operation of the transducer unit is controlled by an on-off switch on the dash and an engagement switch located at the end of the turn signal lever. Two systems for brake release are provided:

An electric switch mounted on the brake pedal disengages the solenoid in the transducer, venting system vacuum to atmosphere through the transducer filter. A vacuum dump valve is also mounted on the brake pedal bracket and vents system vacuum to atmosphere only if the switch on the transducer valve does not function properly.

The operation of each unit of the system and the operation of the entire system under various circumstances is described below.

Engagement Switch (Fig. 15-8)

The engagement switch, located within the turn signal lever, has three positions. In the fully released position, the switch passes current through resistance wire to effect a "hold in" magnetic field in the transducer solenoid. This current is sufficient only to hold the solenoid in place once it has been actuated by the "pull in" circuit. Depressing the button partially allows current to flow to the transducer solenoid at full voltage by-passing the resistance, which causes the solenoid to pull in. Depressing the button fully opens the circuit to both the resistance and standard solenoid feed wires and the solenoid becomes de-activated.

During vehicle operation the three switch positions have the following functions:

a. Switch in Free Position (On-Off Switch "ON")

1. System not engaged: No function of the system will occur although a small current is flowing through the solenoid via the resistance wire.

2. System engaged: The small current flowing through the resistance wire is holding the solenoid in the engaged position.

b. Switch Partially Depressed (On-Off Switch "ON")

Full voltage is applied to the solenoid by passing the resistor (vehicle speed over 30 mph) which sets the transducer to maintain the vehicle speed at the time of transducer engagement.

c. Fully Depressed (On-Off Switch "ON")

No current flows to the solenoid and the transducer is inactive. This position is used by the driver when he desires to raise or lower his controlled speed. He may accelerate to his new speed, press the button fully (transducer releases previously set speed) and release the button. Upon releasing the button, current passes through the partially depressed position and the solenoid is "pulled in", then into released position which provides "hold in" current. The driver may also press the button fully with no pressure on the accelerator pedal. In this case the transducer releases control of the throttle which returns to idle and the car slows. When the button is

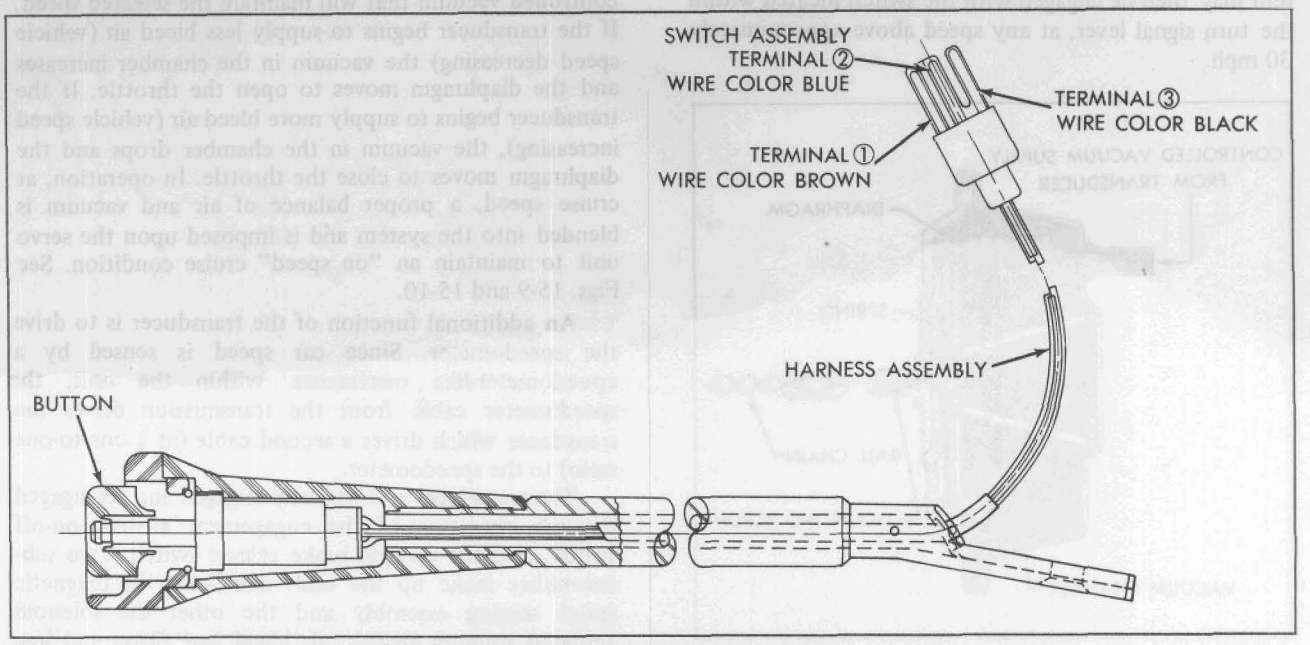


Fig. 15-8 Engagement Switch

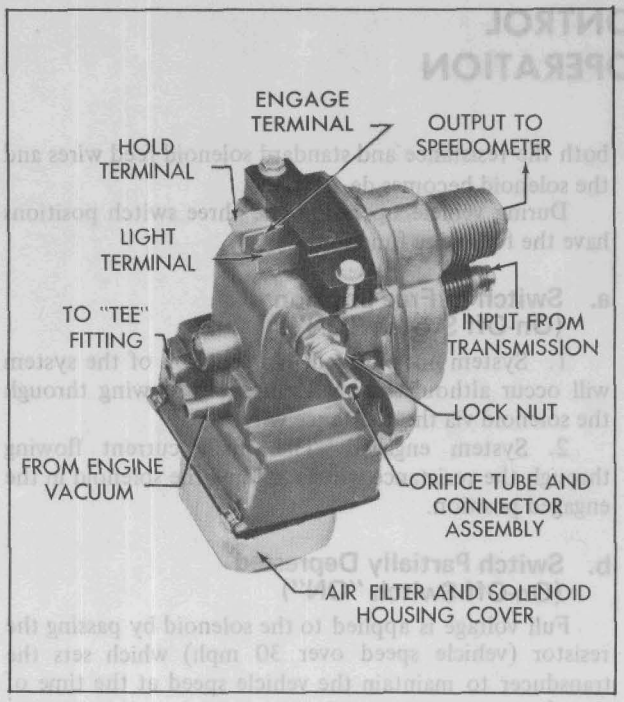


Fig. 15-9 Transducer

released the solenoid is pulled in and held in respectively and the transducer resumes speed control at the speed of the vehicle during the moment of button release (at vehicle speeds over 30 mph).

On-Off Switch

This switch is located to the left side of the steering column on the instrument cluster. The toggle switch completely controls the electrical power to the Cruise Control system. When the switch is in the "OFF" position, the system cannot be engaged. When the switch is in the "ON" position, the "ON" light is lit and the system may then be engaged with the switch located within the turn signal lever, at any speed above approximately 30 mph.

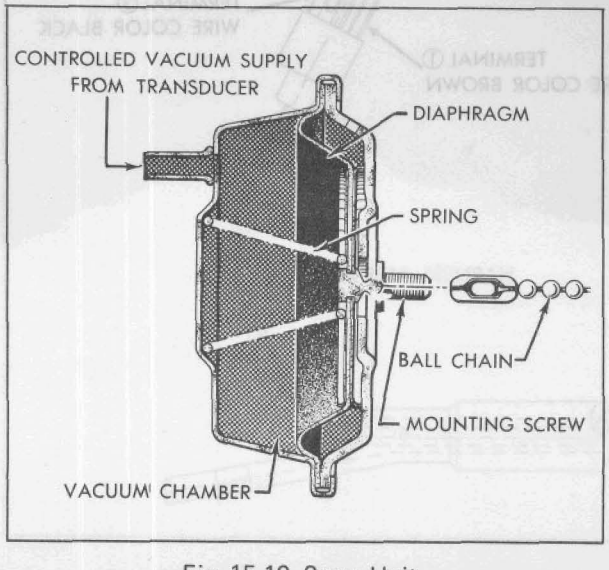


Fig. 15-10 Servo Unit

Brake Release Switches

One brake release switch and one vacuum release valve are employed in the Cruise Control system. When the brake pedal is depressed, an electric release switch cuts off the voltage supplied to the engagement switch, cutting off power to the transducer unit. The transducer is then disengaged and requires engagement switch operation to return it to operation. A vacuum release valve operates after the electric release switch whenever the brake pedal is depressed. In case the electrical switch fails to operate, this switch opens a port to atmospheric pressure that dumps the vacuum in the servo unit thereby returning the throttle to the idle position, as long as the brake is depressed.

Servo Unit

The servo unit is a vacuum actuated, variable position diaphragm assembly that operates the carburetor throttle when the system is in operation. It is powered by controlled vacuum from the transducer and operates the throttle linkage via a bead chain. The servo has a port on the sealed side of the diaphragm housing. When controlled vacuum is applied to this port, atmospheric pressure moves the diaphragm which pulls on the bead chain opening the carburetor throttle.

Transducer

The transducer is located on the cowl near the centerline of the car. The device has two primary functions. First, it is a vacuum switch which, when engaged by the driver, supplies vacuum to a "Tee" fitting. Second, it allows the clutch spring of a metering valve wire and spring assembly to grasp the rubber clutch fixed to the speed cup spindle assembly and meters a small variable quantity of air to the system where it blends with vacuum, thus providing the servo unit with controlled vacuum that will maintain the selected speed. If the transducer begins to supply less bleed air (vehicle speed decreasing) the vacuum in the chamber increases and the diaphragm moves to open the throttle. If the transducer begins to supply more bleed air (vehicle speed increasing), the vacuum in the chamber drops and the diaphragm moves to close the throttle. In operation, at cruise speed, a proper balance of air and vacuum is blended into the system and is imposed upon the servo unit to maintain an "on speed" cruise condition. See Figs. 15-9 and 15-10.

An additional function of the transducer is to drive the speedometer. Since car speed is sensed by a speedometer-like mechanism within the unit, the speedometer cable from the transmission drives the transducer which drives a second cable (at a one-to-one ratio) to the speedometer.

The transducer is electrically engaged and disengaged through operation of the engagement switch, on-off switch, and the electric brake release switch. Two subassemblies make up the unit: one being the magnetic speed sensing assembly and the other the solenoid actuated vacuum switch, air bleed and filter, and low limit speed switch assembly. See Fig. 15-11.

a. Magnetic Speed Sensing Assembly

The speed sensing assembly operates in the same manner as a speedometer unit except that instead of rotating a needle through an angle proportional to vehicle speed, it rotates a rubber drum which is clutched to the air bleed valve when the system is in operation. The assembly is driven by the speedometer cable from the transmission which turns a disk shaped ferrite magnet.

Facing the magnetic disk is the driven disk mounted on a shaft with the rubber drum mounted on the same shaft. A spiral hairspring connects the shaft to the housing and allows it to rotate through an angle which is proportional to car speed. If the car doubled its speed, the shaft would rotate to twice its previous angle as may be seen by noting the operation of a speedometer. The driven disk is sandwiched between the magnetic disk and a field plate. The field plate forms a returning path for the magnetic field from the magnetic disk.

The input shaft drives both the magnetic disk and the speedometer drive cable.

b. Vacuum Switch, Air Bleed and Filter, and Low Limit Speed Switch

The end of the shaft from the speed sensing assembly has a rubber drum which extends into the air bleed metering assembly. This rubber drum has a tang extending from its surface which allows a set of points to close at a specific car speed. When the car reaches about 30 mph, the rubber drum has rotated far enough (moved by the driven disk in the magnetic field) so that its tang has allowed a spring loaded electrical point to contact another point. These points are in series with the solenoid coil so that below 30 mph, no transducer operation is possible.

Surrounding the rubber drum is a "U" shaped spring clip which is held spread away from the drum by the nose or cam of the solenoid when the solenoid is in the relaxed position. The rubber drum and this clip comprise the speed clutch of the transducer. When the solenoid is energized, the solenoid nose moves toward the drum and releases the ends of the clip. The clip springs inward and attaches itself by friction to the drum. Now, any change in car speed will rotate the drum and move the "U" clip just as a speedometer moves its needle. The top of the "U" clip is attached to the air bleed valve. The clip moves a sleeve which slides on the orifice tube thereby covering and uncovering air ports in the wall of the tube (the tube inner end is plugged) whenever car speed changes from the speed at which the solenoid was energized. The direction of drum rotation is such that resulting bleed valve operation will cause the servo to decrease engine power if the car exceeds the preset speed and increase engine power if car speed decreases. The air which passes out the orifice tube enters the transducer through the openings in the solenoid housing, passes through the oil wetted polyurethane filter, and then enters the orifice tube ports.

When the solenoid is de-energized, the nose retracts and cams the ends of the "U" clip outward so that it releases the rubber drum.

The solenoid also operates a vacuum valve simultaneously with the clutching and declutching of the "U" clip. The solenoid operated vacuum valve slides over two ports in the transducer wall. One port is connected to manifold vacuum and the other is connected to the

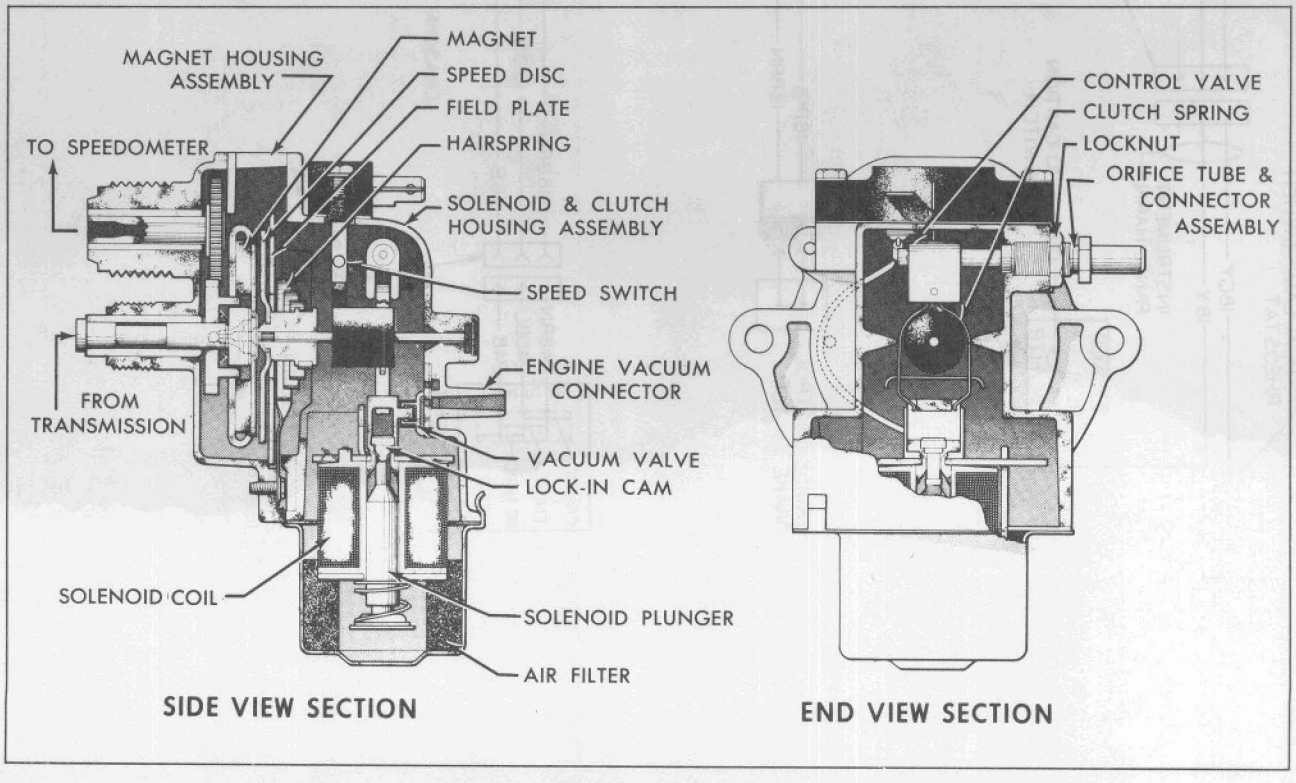


Fig. 15-11 Transducer - Cross Section

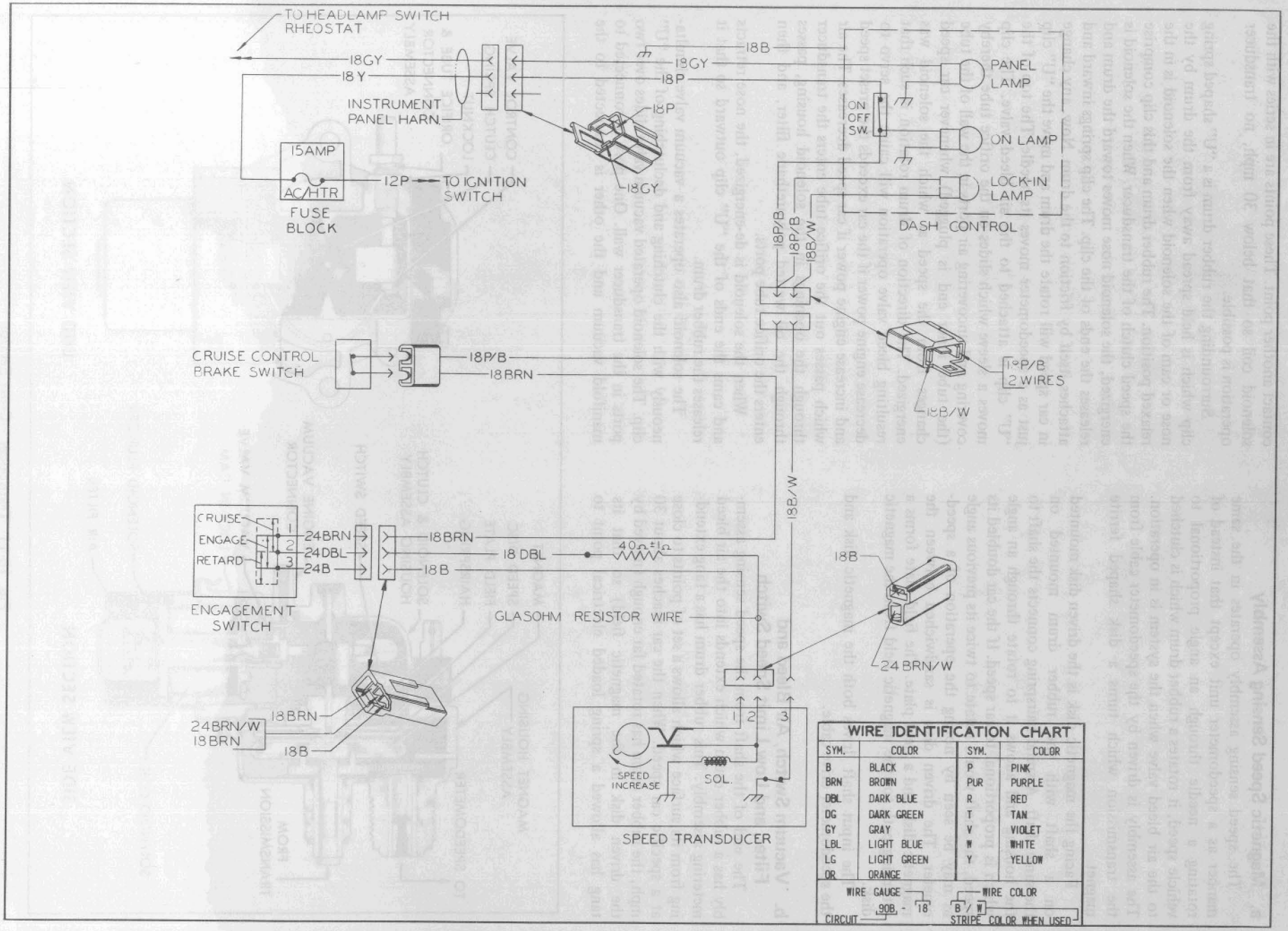


Fig. 15-12 Cruise Control Electrical Diagram

system. When the solenoid is de-energized, the valve closes the manifold vacuum port and opens the system to the inside of the transducer case. When the solenoid is energized, the valve connects manifold vacuum to the system, at which point air is blended to the proper proportion and impressed upon the servo unit according to the dictates of the metering valve.

During system operation the following events occur:

1. Car speed below 30 mph--no function of the pull-in circuit because the rubber drum has not rotated far enough to close the solenoid points. No pull-in current can flow through the solenoid coil. The solenoid coil is receiving a small current via the 40 ohm resistance wire unless the brake pedal is depressed, engagement switch is fully depressed, ignition switch is Off, or On-Off switch is Off.

2. Car speed above 30 mph--the tang on the rubber drum has closed the solenoid points. The pull-in circuit is now ready for engagement.

3. Driver partially depresses engagement switch--full current flows through the solenoid to pull it into operation. The solenoid cam tension on the "U" clip is now released and the clip grips the rubber drum. Also the solenoid plunger completes the ground for the Cruise Control Cruise light. Simultaneously, the vacuum switch applies manifold vacuum to the system. Here the vacuum is blended with air being introduced from the transducer. The balance of air and vacuum is impressed upon the servo to provide for initial throttle positioning.

4. Driver releases the engagement switch--current flows to the solenoid through he 40 ohm wire and since the solenoid is "pulled in", the reduced current flow is sufficient to hold it in position and the cruise light remains On.

5. The car begins to ascend a hill--car speed drops slightly (very slightly) and the magnetic force on the driven disk of the speed sensor is decreased. The disk rotates slightly (as would a speedometer shaft because of hairspring tension) turning the rubber drum. Since the "U" clip is gripping the drum, it moves the air bleed valve in that direction which covers more of the air bleed ports. With less air bleeding into the system, a higher vacuum level is achieved at the servo diaphragm, opening the throttle angle to correct for the underspeed condition.

6. The car begins to descend a hill--car speed increases slightly and the air bleed valve moves in that direction which uncovers the air bleed ports. With more air bleeding into the system, a lower vacuum level is achieved at the servo diaphragm decreasing the throttle angle to correct for the overspeed condition.

7. Driver accelerates by pressing accelerator pedal--car speed increases and the system responds by moving the diaphragm to decrease throttle opening. Since a bead chain is used, the chain merely relaxes and has no effect on throttle operation. After the driver releases pressure from the pedal, the throttle will close until car speed decreases to the preset speed. At that point the transducer bleeds less air to the "Tee" fitting which opens the throttle enough to maintain the preset speed. The system returns to a stable condition.

8. Driver desires higher controlled speed, presses accelerator until new speed is reached, and depresses engagement switch fully and releases button--speed sensing assembly tries to turn in a direction that would decrease the throttle opening until the driver fully depresses the engagement switch. Then the current is cut off to the solenoid which retracts; the solenoid cam expands the "U" clip releasing its grip on the rubber drum and removes the ground from the cruise light. The drum and disk assembly then rotates to a new position because of the higher car speed. When the solenoid retracts, it also shuts off vacuum to the system and opens the vacuum port to atmospheric pressure within the transducer thereby bleeding down the servo toward the relaxed position. As the driver releases the engagement switch, "pull-in" and "hold-in" of the solenoid occur. The system is now engaged to maintain the car speed at the time of engagement switch release and the cruise light is on.

9. Driver desires lower cruising speed, presses engagement switch fully, waits until car speed decreases to desired speed then releases switch--when the engagement switch is fully depressed the solenoid is de-energized causing the vacuum switch to bleed down the servo to idle throttle position and the "U" clip of the air bleed valve is released from the rubber drum. The drum and disc assembly is free to rotate to a position which corresponds to vehicle speed as the car slows. When the driver releases the engagement switch, the unit "pulls-in" and "holds-in" in the normal manner. The air bleed valve is clutched to the rubber drum at the car speed corresponding to switch release. Vacuum is again applied to the system and throttle control is assumed by the transducer to maintain the car speed at the time of switch release.

10. With system in operation, driver applies brakes--the electric release switch disengages the system first, then the vacuum valve operates. The Electric Release Switch cuts off power to the entire system, the solenoid is de-energized, the cruise light is de-energized, and the vacuum inside the transducer is vented to atmosphere. The vacuum valve can also vent the system if the brake pedal is depressed far enough. If the driver removes his foot from the brake pedal the electric switch again feeds voltage to the engagement switch and the vacuum switch seals the air bleed line. The unit will not re-engage since it receives only a small current through the 40 ohm resistance wire. If vehicle speed is below 30 mph the system may not be re-engaged since the tang on the rubber drum has opened the low limit switch points in the transducer.

DIAGNOSIS

10. Electrical System Check-Out (Fig. 15-12)

1. Check fuse and connector.

2. Check electric brake switch as follows: Unplug connector at switch. Connect ohmmeter at two terminals on brake switch. The ohmmeter must indicate

infinity when the pedal is depressed from 1/8" to 1/2" travel and continuity when pedal is released. Replace electric brake switch if needed.

3. Check engagement switch and connecting wiring as follows: Unplug engagement switch connector (brown, blue, black) at electrical wiring harness connector and perform the following tests. (See Fig. 5-12.)

a. Test #1 – Connect ohmmeter between terminal #1 (brown wire) and terminal #2 (blue wire). Continuity should be maintained until switch is depressed all the way in.

b. Test #2 – Connect ohmmeter between terminal #1 (brown wire) and terminal #3 (black). No continuity should be shown; however, when the button is depressed halfway, continuity should be indicated. When the button is depressed all the way down, no continuity should be shown.

c. Test #3 – Connect ohmmeter between terminal #2 (blue wire) and terminal #3 (black). Button released, no continuity; however, when the button is depressed partially and fully, continuity should be shown.

4. Disconnect engagement switch wire harness connector from the main harness connector (brown, brown/white, and black wires). Connect ohmmeter between brown/white stripe wire in main wire harness and ground. Make sure the transducer is well grounded to the chassis. The ohmmeter should read between 42 and 49 ohms. If a resistance either above or below the value indicated is shown, then disconnect the connector from the transducer and measure the resistance of the brown/white stripe wire. It should measure 40 ohms ± 2 ohms. If a resistance either above or below the value indicated is shown, the main wiring harness should be replaced.

(NOTE: When disconnecting or reconnecting the main wiring harness connector from the transducer, care should be exercised not to damage the blade connectors or the wiring harness. The disconnect may be facilitated by prying carefully on the plastic connector with a small bladed screwdriver.)

CRUISE CONTROL DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Will not engage - System Inoperative.	On-Off switch "off".	Turn to "on" position.
	Brake switch circuit open.	Check connections - adjust or replace switch. Refer to Electrical Check-Out.
	Fuse blown.	Replace fuse - if it blows again, check for: 1. Incorrect wiring - Refer to Electrical Check-Out. 2. Short to ground - Refer to Electrical Check-Out.
	Defective engagement switch.	Replace as needed - Refer to Electrical Check-Out.
	Vacuum leak in servo and/or brake valve and connecting lines. Vacuum hose not connected to vacuum valve.	Vacuum test and repair or replace as needed. Refer to Servo and Vacuum System Check-Out.
	Vacuum release valve misadjusted (always open).	Readjust valve.
	Crossed hoses at transducer.	Reroute hoses.
	Pinched or plugged hose that is connected to the servo.	Free or replace hose.
	Open in wiring harness.	Repair or replace as needed.
	Defective transducer.	Replace transducer.
Does not cruise at engagement speed.	Orifice tube misadjusted.	Adjust as required.

CRUISE CONTROL DIAGNOSIS CHART (Cont'd)

CONDITION	CAUSE	REMEDY
System hunts, pulses, or surges.	Kinked or deteriorated hoses (air leak).	Repair or replace.
	Defective and/or improperly positioned drive cables and/or casing assemblies.	Repair or replace as needed.
	Defective transducer.	Replace transducer.
System does not disengage - with brake pedal.	Brake switch misadjusted or defective.	Adjust or replace as required. Refer to Servo and Vacuum System Check Out and Electrical Check Out.
System steadily accelerates or applies full throttle when engaged.	Manifold vacuum connected directly to servo.	Reroute hose.
	Defective transducer.	Replace transducer.
Cannot adjust speed downward with engagement button.	Defective engagement switch or wiring.	Replace as needed. Refer to Electrical Check-Out.
Does not engage or engages lower than limits referred to in "Driver Operation".	Defective transducer.	Replace transducer.
System operates correctly, but constant vacuum bleed when system is disengaged.	Crossed vacuum hoses at transducer.	Reroute hoses.
System can be engaged at idle by depressing switch, but will drop out when switch is released. Solenoid can be heard when switch is depressed when the vehicle is standing still.	Wires reversed at transducer.	Reverse wires - See Fig. 15-12
On light will not turn on even though system cruises satisfactorily.	Defective bulb.	Replace.
Cruise light will not turn on even though system cruises satisfactorily.	Defective bulb or defective ground circuit in transducer.	Replace bulb check cruise light wiring and/or connections or replace transducer.

When measuring the solenoid coil circuit resistance between the hold terminal and ground, the ideal ohmic resistance should be between 5 and 6 ohms. A reading of less than 4 ohms indicates shorting in the coil circuit. A reading of more than 7 ohms indicates excessive resistance in the coil circuit. Either extremity indicates replacement of the transducer assembly. The black main wiring harness from the switch to the transducer should also be checked for continuity.

BUTTON POSITION	TERMINALS		
	1 to 2	1 to 3	2 to 3
Cruise (released)	closed	open	open
Engage (Partially depressed)	closed	closed	closed
Trim (fully depressed)	open	open	closed

5. To check the cruise light circuit, first check bulb. If found satisfactory, refer to electrical schematic and

(a) Turn ignition switch and cruise control switch on.

(b) Connect a jumper lead between light terminal connector on transducer and ground.

(c) If cruise light comes on, transducer replacement is indicated. If cruise light does not come on, check cruise light wiring and/or connections.

11. Servo and Vacuum Check-Out (Fig. 15-13)

To determine the condition of the diaphragm, remove hose from servo unit and apply 14 inches of vacuum to the tube opening and hold in for one minute. The vacuum should not leak down more than 5 inches of vacuum in one minute. If leakage is detected, replace servo. To utilize engine as a vacuum source, proceed as follows:

1. Disconnect servo bead chain and hose from servo then connect engine vacuum directly to the servo fitting.
2. Note position of servo diaphragm.
3. Start engine - the diaphragm should pull in.
4. Clamp off engine vacuum supply line and check for leakage.

The cruise release brake switch (vacuum) and connecting hoses can likewise be checked using a vacuum pump.

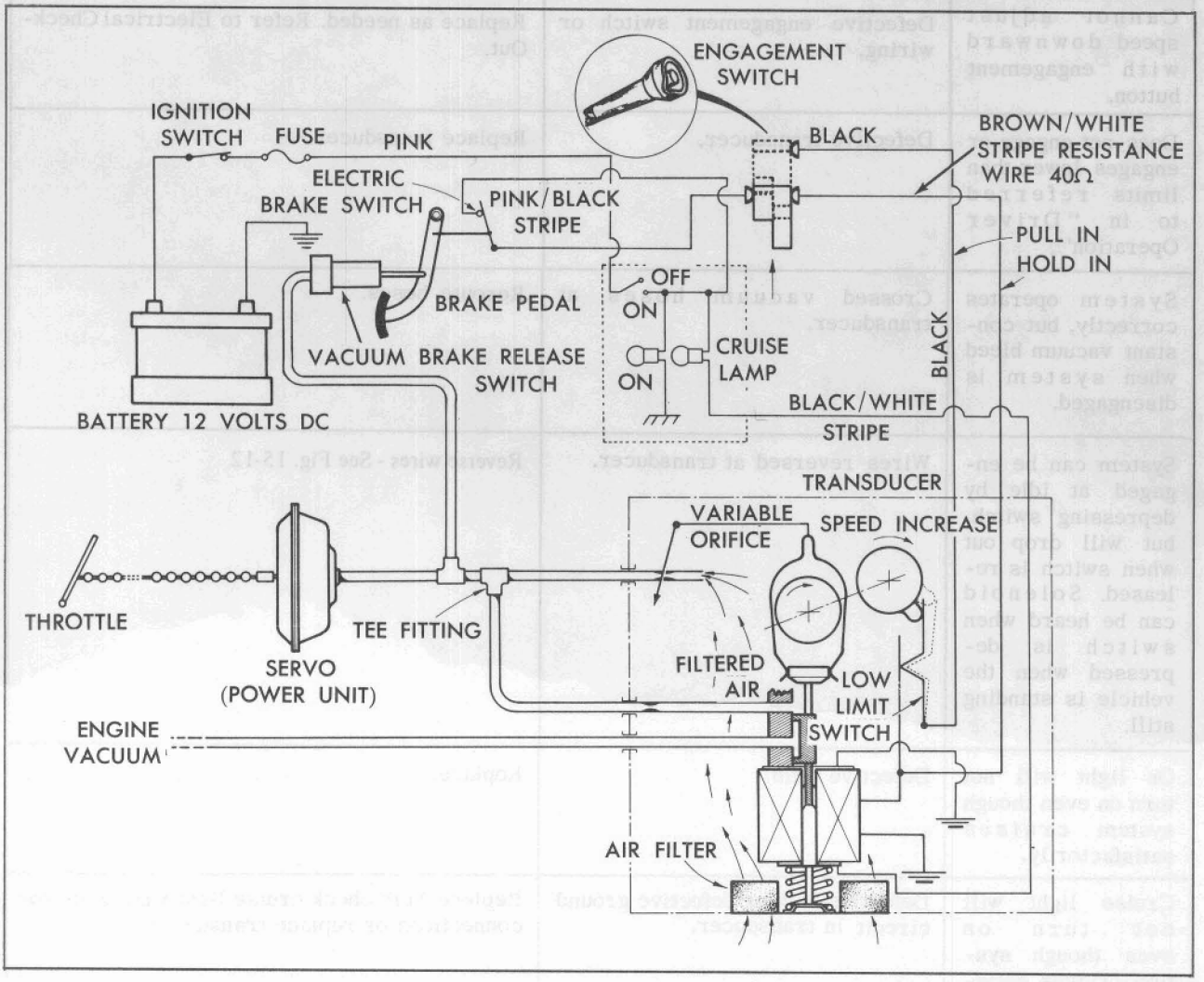


Fig. 15-13 Vacuum and Electrical Diagram

SERVICE INFORMATION

The components of the Cruise Control system are designed to be replaced should they become inoperative.

The transducer is calibrated in such a manner during manufacturing that overhaul operations are impractical. However, one adjustment may be made to the transducer to correct speed drop or increase at the time of engagement.

12. Brake Release Switch and Valve

a. Electric

Service – An inoperative switch must be replaced. Install new switch and adjust by loosening switch mounting screw, repositioning switch, and tightening screw.

Adjustment – With ignition and Cruise Control on, use a test light at the switch terminal. The brake switch must break the electrical contact when the pedal is depressed approximately 1/8-1/2 inch, but in any case it must be adjusted to disengage the system before the dump valve, otherwise a hiss will be heard inside the car when the brakes are applied.

b. Vacuum

Service – An inoperative (sticking, plugged, or leaking) valve must be replaced. Be certain that the hose to the switch is connected firmly and is not cracked or deteriorated.

Adjustment – The vacuum valve should be pushed all the way into the retaining clip. Pulling the brake pedal up to the stop will automatically adjust valve.

13. Engagement Switch

The engagement switch cannot be serviced. The complete turn signal lever must be replaced as an assembly.

a. Removal

1. Disconnect battery ground cable.
2. Remove steering column lower cover and slide column harness protector down out of way.
3. Disconnect cruise control switch harness connector and attach a long piece of piano wire to switch connector.
4. On T & T steering columns, perform the following:

a. Before unscrewing the turn signal lever, make a small hook in a thin piece of stiff wire.

b. Insert wire in turn signal lever opening.

c. Using wire, gently pull Cruise Control harness out through opening.

d. Gently pull remainder of harness up through and out of column.

e. Disconnect guide wire from connector and secure wire to column.

(NOTE: Wire must be used so that Cruise Control harness can be guided through the proper passages on installation.)

f. Unscrew turn signal lever, being sure to pass Cruise Control harness over the lever each time the turn signal lever makes one complete turn.

g. Remove turn signal lever from car.

5. On standard steering columns, proceed as follows:

a. Remove steering wheel as described in Section 9, Note 18a.

CAUTION: When laying wheel facing down, place a cloth on work bench to prevent wheel from being scratched or marked.

b. Remove three screws securing lock plate cover assembly to lock plate and remove cover assembly, Fig. 9-46.

c. Working through lock plate, remove screw securing turn signal lever and remove lever and harness. Pull harness up gently so guide wire can be used to install new unit.

b. Installation

1. Attach upper end of piano wire to switch harness connector and pull piano wire at lower end of column, feeding harness into proper location in column.
2. On T & T steering columns, perform the following:

a. Gently pull harness down through steering column cover part way.

b. Allow Cruise Control lever to hang free, with approximately 16" of wire out of column. Then, rotate turn signal lever in a clockwise direction six times, permitting Cruise Control harness to make six loops.

c. Insert turn signal lever into opening in column.

d. Screw turn signal lever into position, passing the Cruise Control harness over the turn signal lever each time you complete one full turn of the lever.

CAUTION: The harness must be passed over the lever each time the lever makes one complete turn to prevent damaging the harness where it enters into the turn signal lever. The wire loops will unwind as the lever is screwed in and wires will be straight in the column.

e. After lever is installed, gently pull remainder of harness through column and into position.

3. On standard steering columns, proceed as follows:

a. Position turn signal lever on turn signal switch. Working through lock plate, secure lever to switch with one screw. Tighten screw to 30 inch-pounds.

b. Position cover assembly on upper end of column and install three screws securing cover to lock plate.

c. Install steering wheel as described in Section 9, Note 18b.

d. Remove guide wire from switch harness.

4. Disconnect piano wire from switch harness and reconnect harness.
5. Slide column harness protector up into position and install column lower cover.
6. Connect battery ground cable.

14. Servo

a. Service

If the servo unit is found to be defective, replace-

ment is required. Note the condition of the hoses and replace any which are cracked or deteriorated.

b. Adjustment

No adjustment should be necessary to the bead chain if the proper chain has been installed.

15. Transducer

a. Maintenance

A defective transducer (one which is not simply out of adjustment) must be replaced. During replacement, check the hoses which connect to the transducer and replace any which are cracked or deteriorated.

b. Adjustment

One transducer adjustment is possible: Engagement - Cruising Speed Zeroing (to remove any difference between engagement and cruising speed). No transducer adjustment should be made, however, until the following items have been checked or serviced:

1. All hoses in good condition, properly attached, not leaking, not pinched or kinked.
2. Electric and vacuum release switches properly adjusted.

c. Engagement–Cruising Speed Zeroing

If the cruising speed is lower than the engagement speed, loosen the orifice tube locknut (see Fig. 15-9) and turn the tube outward; if higher, turn the tube inward. Each 1/4 turn will alter the engagement-cruising speed difference one mph. Tighten the locknut after adjustment and check the system operation at 60 mph.

GUIDE-MATIC
THEORY OF OPERATION

The Guide-Matic system allows the driver to obtain automatic switching of vehicle headlight beams in response to light from approaching vehicle headlights. Provision is included for the driver to obtain manual control or constant low beam if desired. Guide-Matic is available as optional equipment on all 1972 Cadillac cars.

The system consists of a photo-amplifier, power relay, foot switch, sensitivity control (driver control), and interconnecting wire harness, Fig. 15-14.

The photo-amplifier combines a light sensing photocell and transistorized D.C. amplifier into one unit with sufficient power to operate a power relay for switching the headlight beams. Mounting location is below the radiator cradle tie bar just to left of car center, positioned so the amber colored lens has an unobstructed view of approaching vehicle headlights through the grille. Road signs, reflections from the vehicle's own headlights, and other miscellaneous lights require the vertical and horizontal "viewing range" of the photocell to be rather narrow. Since the "viewing range" is narrow, aim of the photo-amplifier is very important. An adjustment screw for setting correct vertical aim is an integral part of the unit. Instructions for aiming must be followed carefully for correct operation.

The photo-amplifier is adjusted and sealed at the factory. If a failure occurs, the assembly must be replaced.

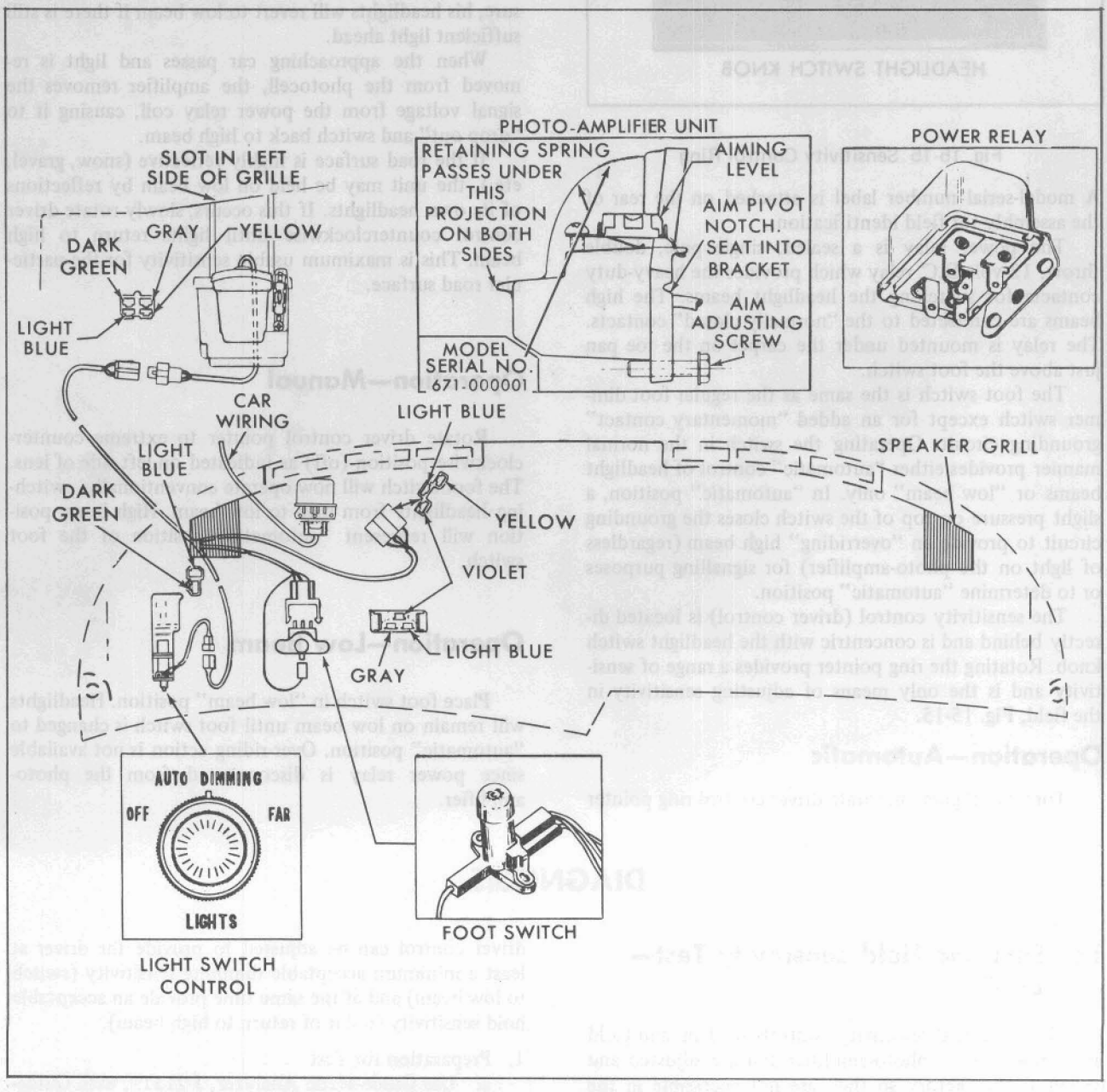


Fig. 15-14 Guide-Matic Components



Fig. 15-15 Sensitivity Control Ring

A model-serial number label is attached on the rear of the assembly for field identification.

The power relay is a sealed, single pole, double throw, 12 volt D.C. relay which provides the heavy-duty contacts for switching the headlight beams. The high beams are connected to the "normally closed" contacts. The relay is mounted under the carpet on the toe pan just above the foot switch.

The foot switch is the same as the regular foot dimmer switch except for an added "momentary contact" grounding circuit. Operating the switch in the normal manner provides either "automatic" control of headlight beams or "low beam" only. In "automatic" position, a slight pressure on top of the switch closes the grounding circuit to provide an "overriding" high beam (regardless of light on the photo-amplifier) for signalling purposes or to determine "automatic" position.

The sensitivity control (driver control) is located directly behind and is concentric with the headlight switch knob. Rotating the ring pointer provides a range of sensitivity and is the only means of adjusting sensitivity in the field, Fig. 15-15.

Operation—Automatic

Turn headlights on, rotate driver control ring pointer to approximately center of rotation, and place foot switch in "automatic" position. If there is no light ahead, the headlights will be on high beam. No warm-up time is required.

When light from an approaching vehicle's headlights reaches a predetermined level at the photocell's sensing surface, the amplifier will trigger (pull-on) the power relay causing it to switch (dim) the headlights from high to low beam. At the same time the photocell sensitivity is increased to "hold" sensitivity to keep headlights on low beam when approaching driver reduces light by switching to low beam.

If the driver desires his lights to switch when the approaching vehicle is farther away or nearer, he may adjust the driver control. Also if the approaching driver fails to dim, he may signal him by momentarily putting a slight pressure on top of the foot switch to "override" his headlights to high beam. When he removes the pressure, his headlights will revert to low beam if there is still sufficient light ahead.

When the approaching car passes and light is removed from the photocell, the amplifier removes the signal voltage from the power relay coil, causing it to "drop out" and switch back to high beam.

If the road surface is highly reflective (snow, gravel, etc.), the unit may be held on low beam by reflections of its own headlights. If this occurs, slowly rotate driver control counterclockwise until lights return to high beam. This is maximum usable sensitivity for the particular road surface.

Operation—Manual

Rotate driver control pointer to extreme counterclockwise position (off) as indicated on left side of lens. The foot switch will now operate conventionally, switching headlights from high to low beam. High beam position will represent "automatic" position of the foot switch.

Operation—Low Beam

Place foot switch in "low beam" position. Headlights will remain on low beam until foot switch is changed to "automatic" position. Over-riding action is not available since power relay is disconnected from the photo-amplifier.

DIAGNOSIS

16. Dim and Hold Sensitivity Test—on Car

The individual sensitivity controls for Dim and Hold are located in the photo-amplifier and are adjusted and sealed at the factory so they are not accessible in the field. The sensitivity check is only to determine if the driver control can be adjusted to provide the driver at least a minimum acceptable dimming sensitivity (switch to low beam) and at the same time provide an acceptable hold sensitivity (point of return to high beam).

1. Preparation for Test

a. Use Guide-Matic Analyzer, J-21519, with Guide-Matic Analyzer Adapter, J-22622.

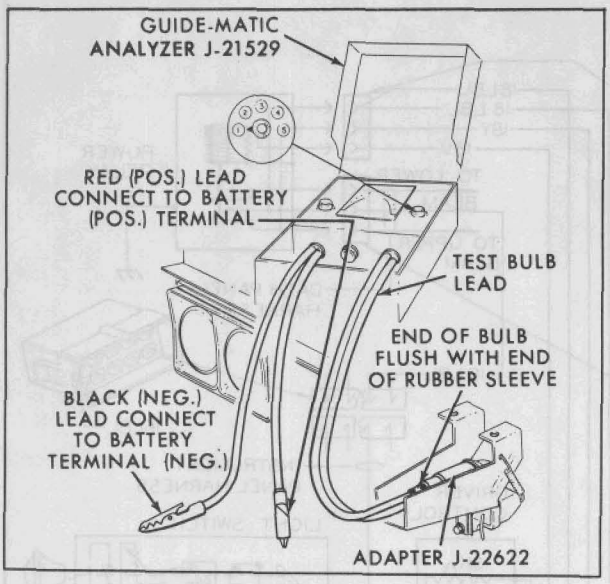


Fig. 15-16 Dim and Hold Sensitivity Test

(NOTE: The test bult assembly plugs into the rear of the adapter head. If bulb burns out, replace with a #53 bulb. Make sure filament of bulb is standing fairly straight up so that a minimum of the side of the filament is exposed to the end of the bulb. The end of the bulb should be approximately flush with the end of its rubber sleeve.)

b. Install analyzer test bulb assembly into smaller diameter hole in rear of adapter head. Push bulb and rubber sleeve forward until they stop against inner bulkhead wall of adapter head, Fig. 15-16.

c. Install and connect analyzer as shown in Fig. 15-17. Be sure adapter is seated snugly around lens and bail is snapped tightly into position. Remove two screws securing photo-amplifier shield, mount the adapter, and reinstall shield. Do not disconnect electrical connectors.

(NOTE: It may be necessary to remove unit to install tester. If so, connect ground wire to unit before operating.)

d. Cover photo-amplifier with black cloth to eliminate outside light.

e. Rotate analyzer function selector switch to #1 position.

f. Rotate driver control ring pointer counterclockwise to "off" position.

g. Turn on headlights and operate engine at fast idle.

h. Place foot switch in automatic position.

2. Test Procedure

a. Adjust analyzer voltage control knob until meter reads 7.0 volts.

b. Slowly rotate driver control ring clockwise just to point where headlights switch to low beam.

c. Check accuracy of driver control adjustment by rotating analyzer voltage control knob counterclockwise until headlights switch to high beam. Then slowly rotate analyzer voltage to control knob clockwise until headlights switch to low beam. Voltmeter should read between 6.5 and 7.0 volts.

d. If reading does not agree, repeat Steps a, b, and c.

e. Rotate analyzer voltage control knob counterclockwise to a reading that is 1.0 volt less than reading obtained for switching to low beam in Step c. Wait four seconds. Headlights should not switch to high beam. Rotate analyzer voltage control knob counterclockwise to a reading that is 3 volts less than reading obtained for switching to low beam in Step c. Headlights should switch to high beam within four seconds.

f. If this minimum dim and hold sensitivity can be obtained at any position of the driver control ring, the unit is acceptable for sensitivity and you may proceed to Step g. If dim (switching to low beam) sensitivity cannot be adjusted (step b), replace defective photo-amplifier. If dim and hold sensitivity readings are close together on the analyzer voltmeter (less than 1 volt), see Fig. 15-17 and check for open #18 yellow wire between power relay and 4-way connector near photo-amplifier. If no open is detected, replace photo-amplifier.

g. Turn off engine, disconnect analyzer, reconnect any wires previously disconnected, and remove black cloth from photo-amplifier. If it was necessary to remove photo-amplifier from bracket, reinstall and perform vertical aiming adjustment as described in Note 17.

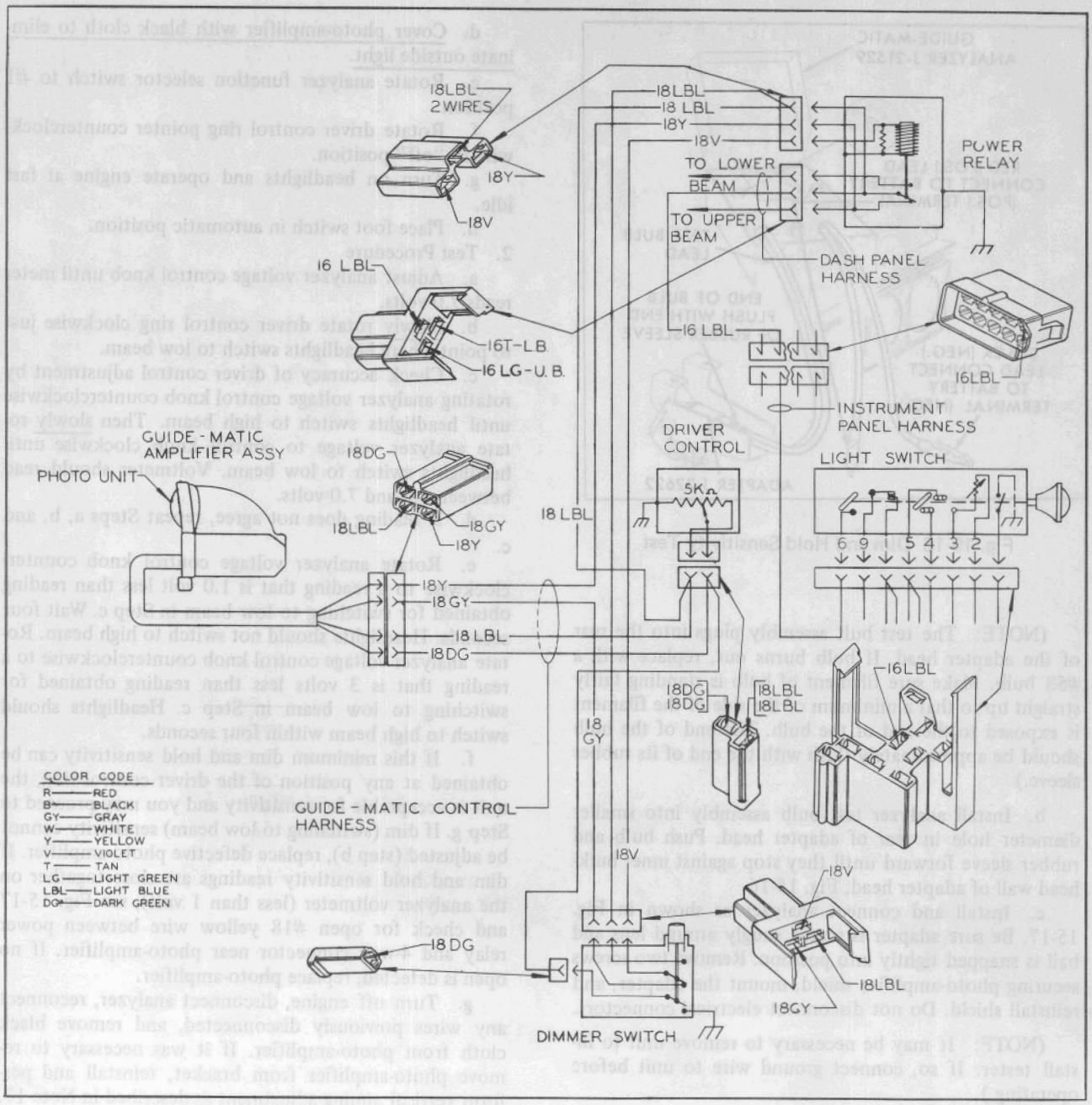
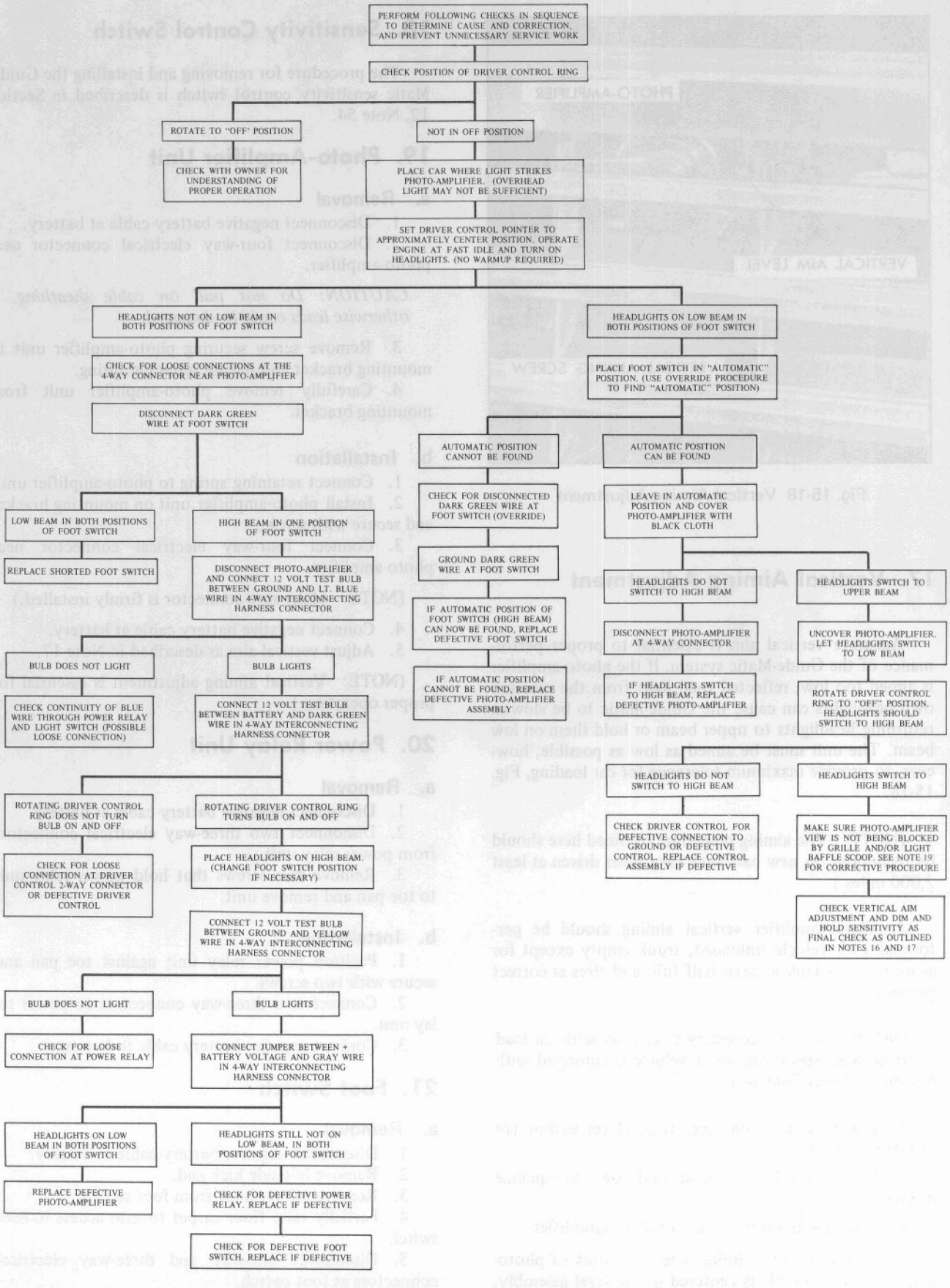


Fig. 15-17 Guide-Matic Circuit Diagram

GUIDE-MATIC DIAGNOSIS CHART



SERVICE INFORMATION

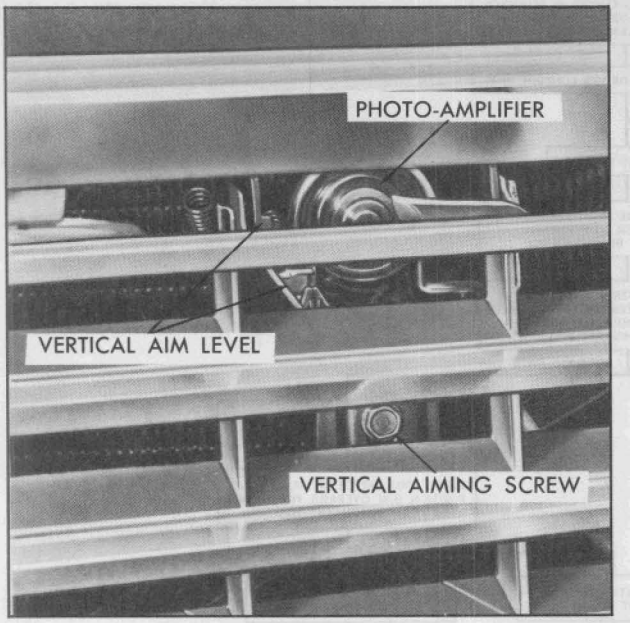


Fig. 15-18 Vertical Aiming Adjustment

17. Vertical Aiming Adjustment

Accurate vertical aim is essential to proper performance of the Guide-Matic system. If the photo-amplifier is aimed too low, reflected road light from the vehicle's own headlights can cause the Guide-Matic to be slow in returning headlights to upper beam or hold them on low beam. The unit must be aimed as low as possible, however, to provide maximum tolerance for car loading, Fig. 15-18.

(NOTE: The aiming procedure outlined here should be rechecked on new cars that have been driven at least 2,000 miles.)

1. Photo-amplifier vertical aiming should be performed with vehicle unloaded, trunk empty except for spare tire, gas tank at least half full, and tires at correct pressure.

(NOTE: It is not necessary to comply with car load or trunk load specifications if vehicle is equipped with Automatic Level Control.)

2. Locate vehicle on level floor (level within 1/4 inch fore and aft).

3. Rock car sideways or up and down to equalize springs.

4. Raise car hood for access to photo-amplifier.

5. Adjust vertical aiming screw at front of photo-amplifier until bubble is centered in the level assembly.

18. Sensitivity Control Switch

The procedure for removing and installing the Guide-Matic sensitivity control switch is described in Section 12, Note 54.

19. Photo-Amplifier Unit

a. Removal

1. Disconnect negative battery cable at battery.
2. Disconnect four-way electrical connector near photo-amplifier.

CAUTION: Do not pull on cable sheathing, otherwise leads could be damaged.

3. Remove screw securing photo-amplifier unit to mounting bracket and release retaining spring.
4. Carefully remove photo-amplifier unit from mounting bracket.

b. Installation

1. Connect retaining spring to photo-amplifier unit.
2. Install photo-amplifier unit on mounting bracket and secure with screw.
3. Connect four-way electrical connector near photo amplifier.

(NOTE: Make sure connector is firmly installed.)

4. Connect negative battery cable at battery.
5. Adjust vertical aim as described in Note 17.

(NOTE: Vertical aiming adjustment is essential for proper operation.)

20. Power Relay Unit

a. Removal

1. Disconnect negative battery cable at battery.
2. Disconnect two three-way electrical connectors from power relay unit.
3. Remove two screws that hold power relay unit to toe pan and remove unit.

b. Installation

1. Position power relay unit against toe pan and secure with two screws.
2. Connect two three-way connectors to power relay unit.
3. Connect negative battery cable to battery.

21. Foot Switch

a. Removal

1. Disconnect negative battery cable at battery.
2. Remove left side kick pad.
3. Remove rubber boot from foot switch.
4. Partially raise floor carpet to gain access to foot switch.
5. Disconnect one-way and three-way electrical connectors at foot switch.

6. Remove two screws that hold foot switch to floor pan and remove foot switch.

b. Installation

1. Install foot switch on floor pan and secure with two attaching screws.
2. Connect one-way and three-way connectors to foot switch.
3. Reposition floor carpet and install left side kick pad.
4. Install rubber boot on foot switch.
5. Connect negative battery cable to battery.

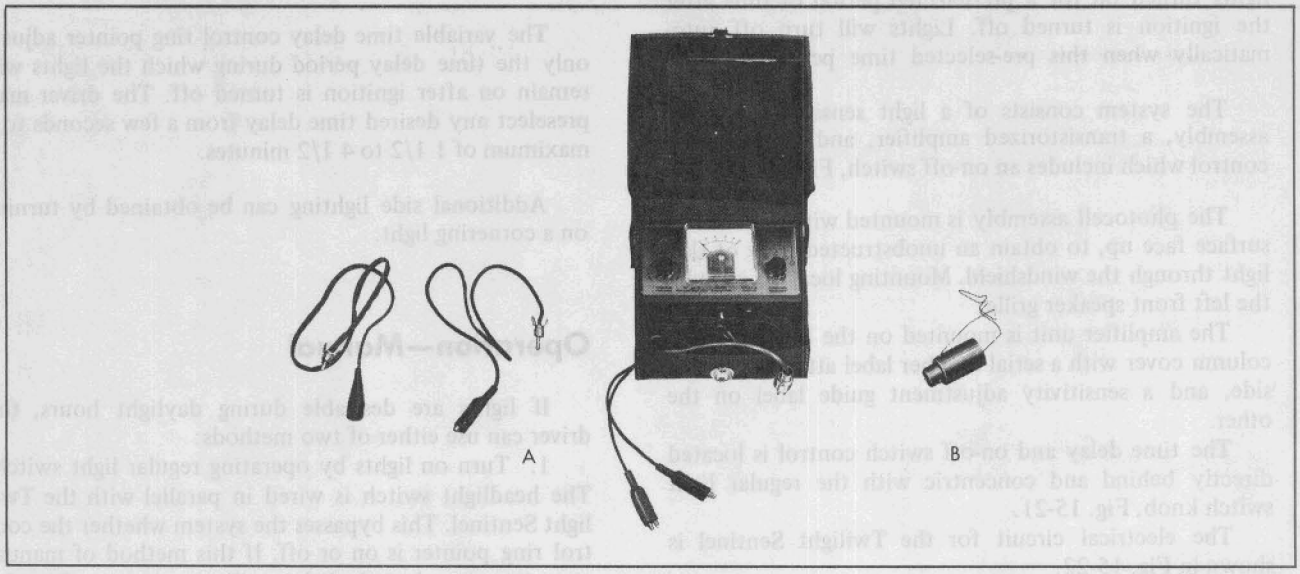


Fig. 15-19 Special Tools—Guide-Matic

Key	Tool No.	Name
A	J-21529	Guide-Matic Analyzer
B	J-22622	Guide-Matic Analyzer Adapter

THEORY OF OPERATION

The Twilight Sentinel is an optional convenience that provides light-sensitive automatic on-off control of the headlights during vehicle operation. In addition, for night visibility when leaving the vehicle, it will keep the lights turned on for a pre-selected period of time after the ignition is turned off. Lights will turn off automatically when this pre-selected time period elapses.

The system consists of a light sensitive photocell assembly, a transistorized amplifier, and a time delay control which includes an on-off switch, Fig. 15-20.

The photocell assembly is mounted with its sensitive surface face up, to obtain an unobstructed view of skylight through the windshield. Mounting location is under the left front speaker grille.

The amplifier unit is mounted on the lower steering column cover with a serial number label attached on one side, and a sensitivity adjustment guide label on the other.

The time delay and on-off switch control is located directly behind and concentric with the regular light switch knob, Fig. 15-21.

The electrical circuit for the Twilight Sentinel is shown in Fig. 15-22.

Operation—Automatic

The Twilight Sentinel system will operate automatically when the following conditions are met: the ignition switch must be on, the headlight switch must be off, and the control ring pointer, Fig. 15-21, must be turned on (any position on the dial counterclockwise from "OFF" position). The system will now turn lights on automatically when evening daylight reduces to the point at which road illumination becomes necessary. As morning daylight increases to the point at which road illumination is no longer necessary, it will turn lights off.

A time delay circuit in the amplifier reduces the possibility of undesired switching on or off of lights while passing under viaducts, trees, bright lights, etc. The time delay is nominally 10 to 30 seconds, but in some units it could be as high as 60 seconds. The length of the time delay is set in production and cannot be altered in the field.

The variable time delay control ring pointer adjusts only the time delay period during which the lights will remain on after ignition is turned off. The driver may preselect any desired time delay from a few seconds to a maximum of 1 1/2 to 4 1/2 minutes.

Additional side lighting can be obtained by turning on a cornering light.

Operation—Manual

If lights are desirable during daylight hours, the driver can use either of two methods:

1. Turn on lights by operating regular light switch. The headlight switch is wired in parallel with the Twilight Sentinel. This bypasses the system whether the control ring pointer is on or off. If this method of manual operation is selected, lights will remain on after the ignition is turned off; however, when he opens the door to leave the car, a warning buzzer grounded through the door jamb switch reminds the driver to turn off the lights.
2. Cover the photocell to block light exposure. This will permit lights to turn on and still permit the Twilight Sentinel to turn lights off in the normal manner when ignition is turned off. (If cell has been exposed to light, the time delay must elapse before lights will turn on.)

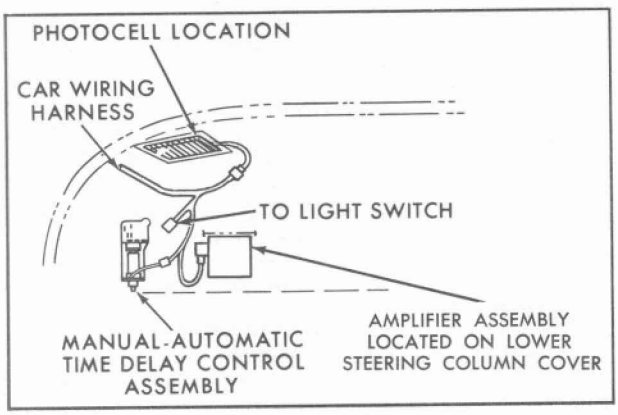


Fig. 15-20 Twilight Sentinel Components

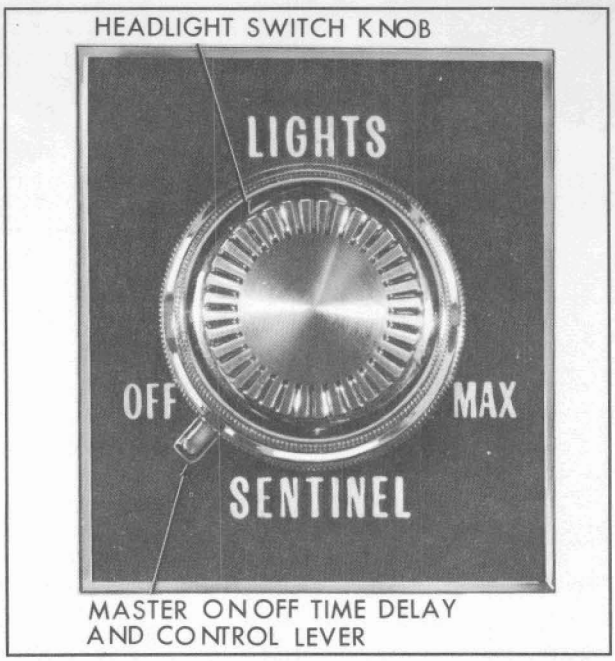
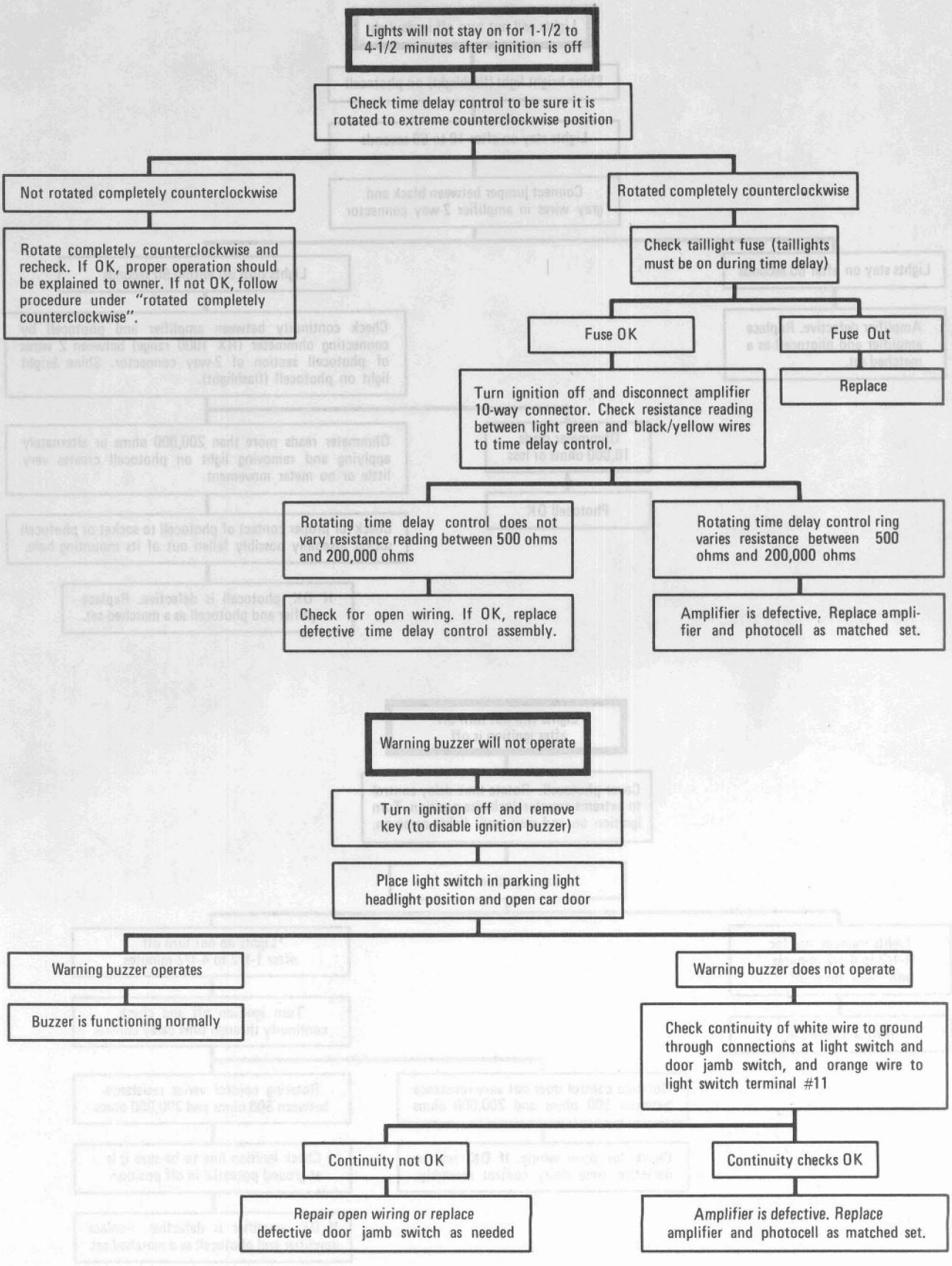
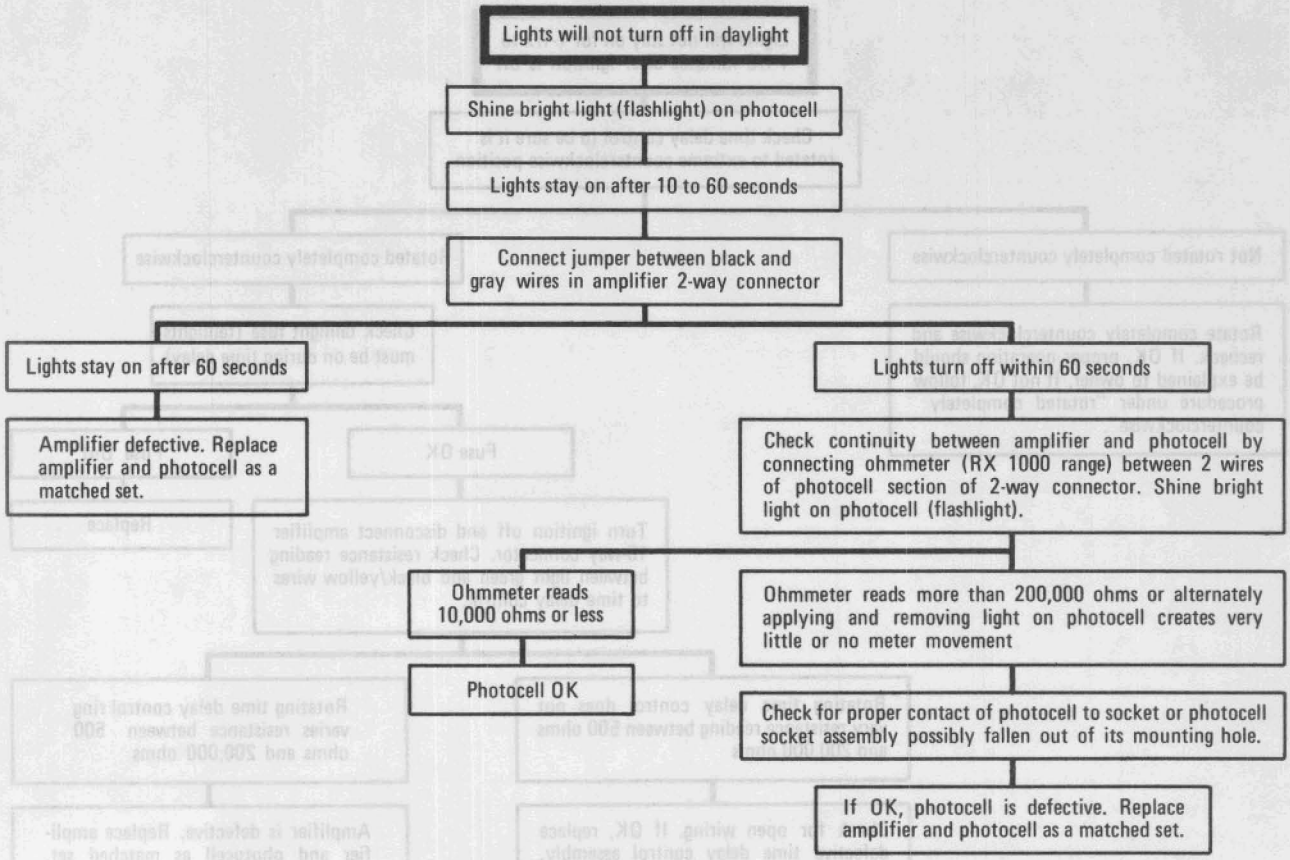


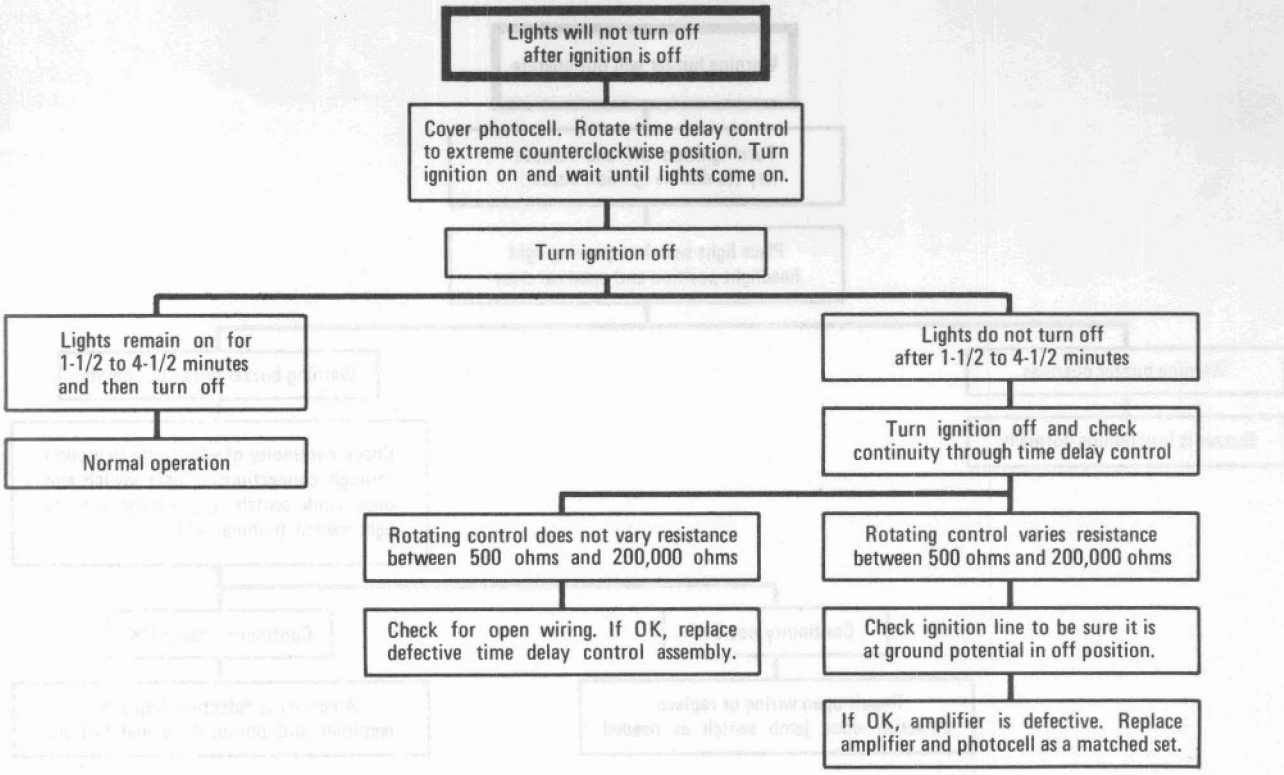
Fig. 15-21 Twilight Sentinel Control Lever

TWILIGHT SENTINEL DIAGNOSIS CHART

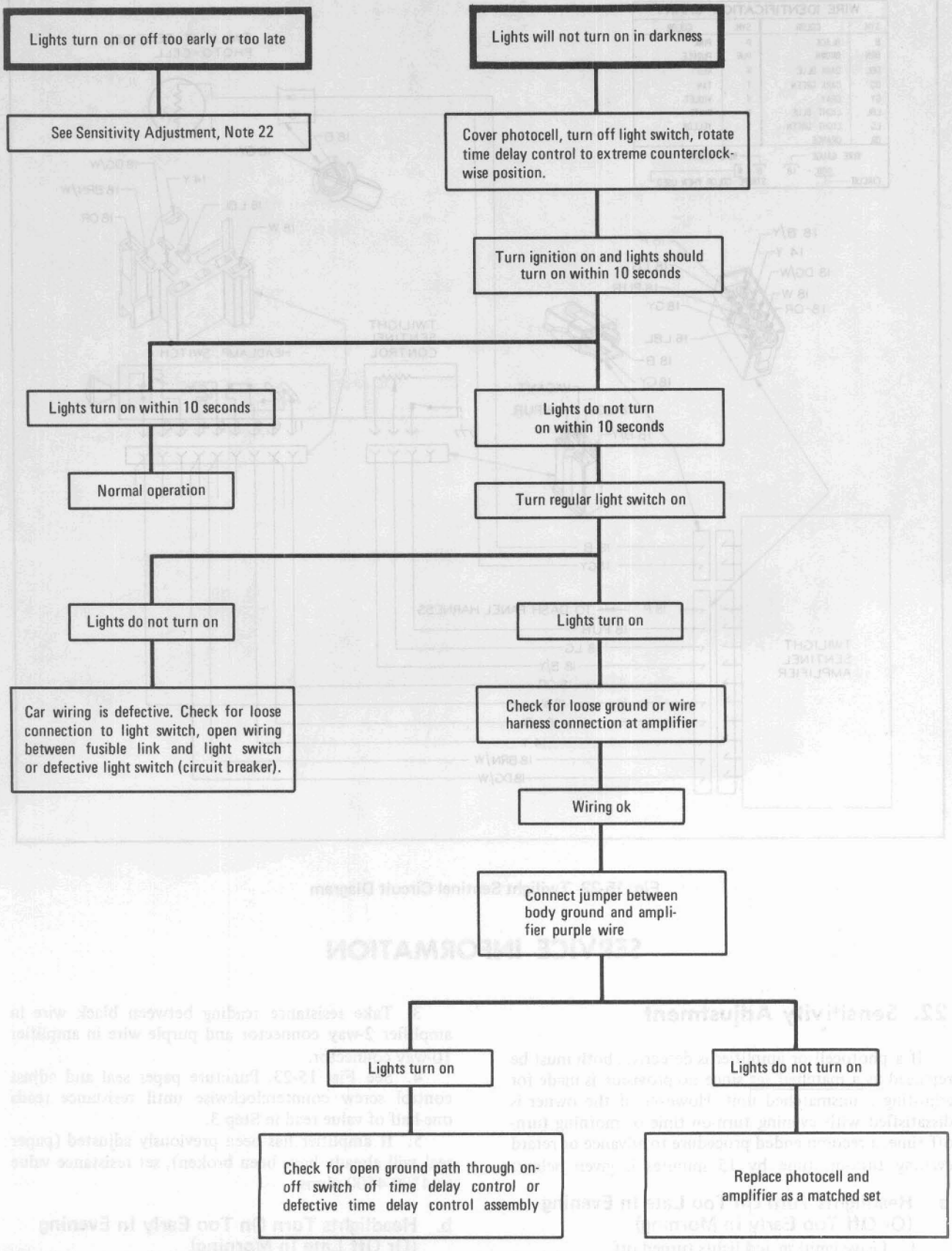


TWILIGHT SENTINEL DIAGNOSIS CHART (Cont'd)





TWILIGHT SENTINEL DIAGNOSIS CHART (Cont'd)



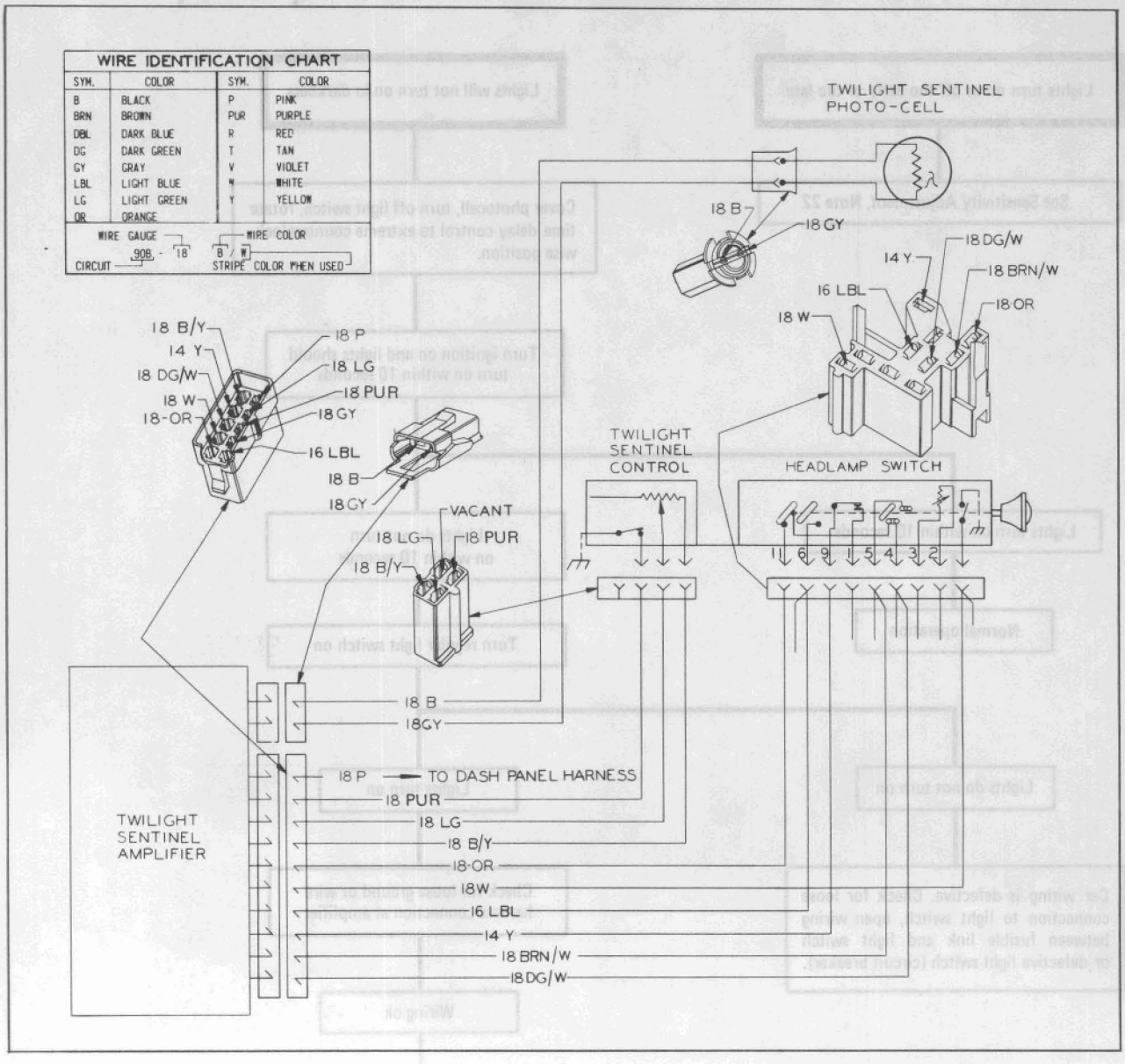


Fig. 15-22 Twilight Sentinel Circuit Diagram

SERVICE INFORMATION

22. Sensitivity Adjustment

If a photocell or amplifier is defective, both must be replaced as a matched set since no provision is made for adjusting a mismatched unit. However, if the owner is dissatisfied with evening turn-on time or morning turn-off time, a recommended procedure to advance or retard evening turn-on time by 15 minutes is given below:

a. Headlights Turn On Too Late In Evening (Or Off Too Early In Morning)

1. Leave ignition and lights turned off.
2. Cover photocell so no light strikes it.
3. Take resistance reading between black wire in amplifier 2-way connector and purple wire in amplifier 10-way connector.
4. See Fig. 15-23. Puncture paper seal and adjust control screw counterclockwise until resistance reads one-half of value read in Step 3.
5. If amplifier has been previously adjusted (paper seal will already have been broken), set resistance value to 4100-4500 ohms.

b. Headlights Turn On Too Early In Evening (Or Off Late In Morning)

Follow same procedure as described in Steps 1

through 5 above except under Step 4 adjust control screw until resistance reads one and one-half times value read in Step 3.

23. Control Switch

The procedure for removing and installing the Twilight Sentinel control switch is described in Section 12, Note 54.

24. Photocell Unit

The procedure for removing and installing the Twilight Sentinel photocell unit is described in Section 12, Note 76.

25. Amplifier Unit

The procedure for removing and installing the Twilight Sentinel amplifier unit is described in Section 12, Note 80.

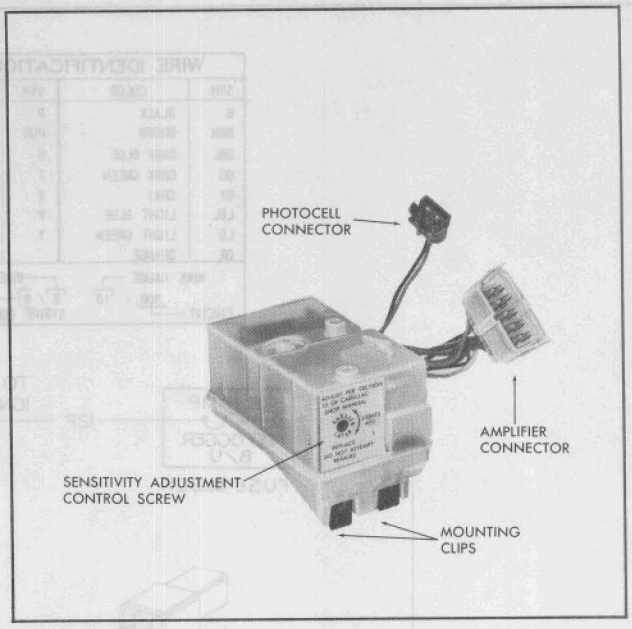


Fig. 15-23 Sensitivity Adjustment Control Screw

REAR WINDOW DE-FOGGER (EXCEPT CONVERTIBLE) THEORY OF OPERATION

The switch for controlling the rear window De-Fogger is located in the accessory switch panel, Fig. 15-24, just above the radio, on all cars except 697 and 698 styles. When the switch is in the far left position, the De-Fogger is OFF. Moving the switch to the center provides LOW blower speed, and to the right, HIGH blower speed. When the switch is in either LOW or HIGH blower speed, the words "REAR DE FOG", just above the switch will light up. The switch electrical diagram is illustrated in Fig. 15-25.

On 697 styles, no separate control switch is provided. The De-Fogger is integral with the rear air conditioning unit, which is standard equipment. This De-Fogger operates whenever the rear air conditioner is operating in the heater mode.

The Rear Window De-Fogger is not offered for 698 styles.



Fig. 15-24 Rear De-Fogger Control Switch (Except Convertible)

REAR WINDOW DE-FOGGER (CONVERTIBLE ONLY) THEORY OF OPERATION

The rear window De-Fogger for the Eldorado convertible is an electrically heated back light and is available only as a factory installed accessory. The convertible De-Fogger differs from the De-Fogger installed in all other series cars in that it operates all electrically. It does not use a blower motor, hoses, or ductwork. The convertible De-Fogger switch electrical diagram is illustrated in Fig. 15-26.

The switch for controlling the De-Fogger is located in the accessory switch panel, just above the radio. Momentarily moving the spring loaded switch to the "ON" position energizes a time-delay relay. The time-delay relay is fed current from the fuse block through a 25 amp. in-line fuse. Current then flows from the relay to the heated back light. The heated back light consists of silver ceramic electrically conductive horizontal grid

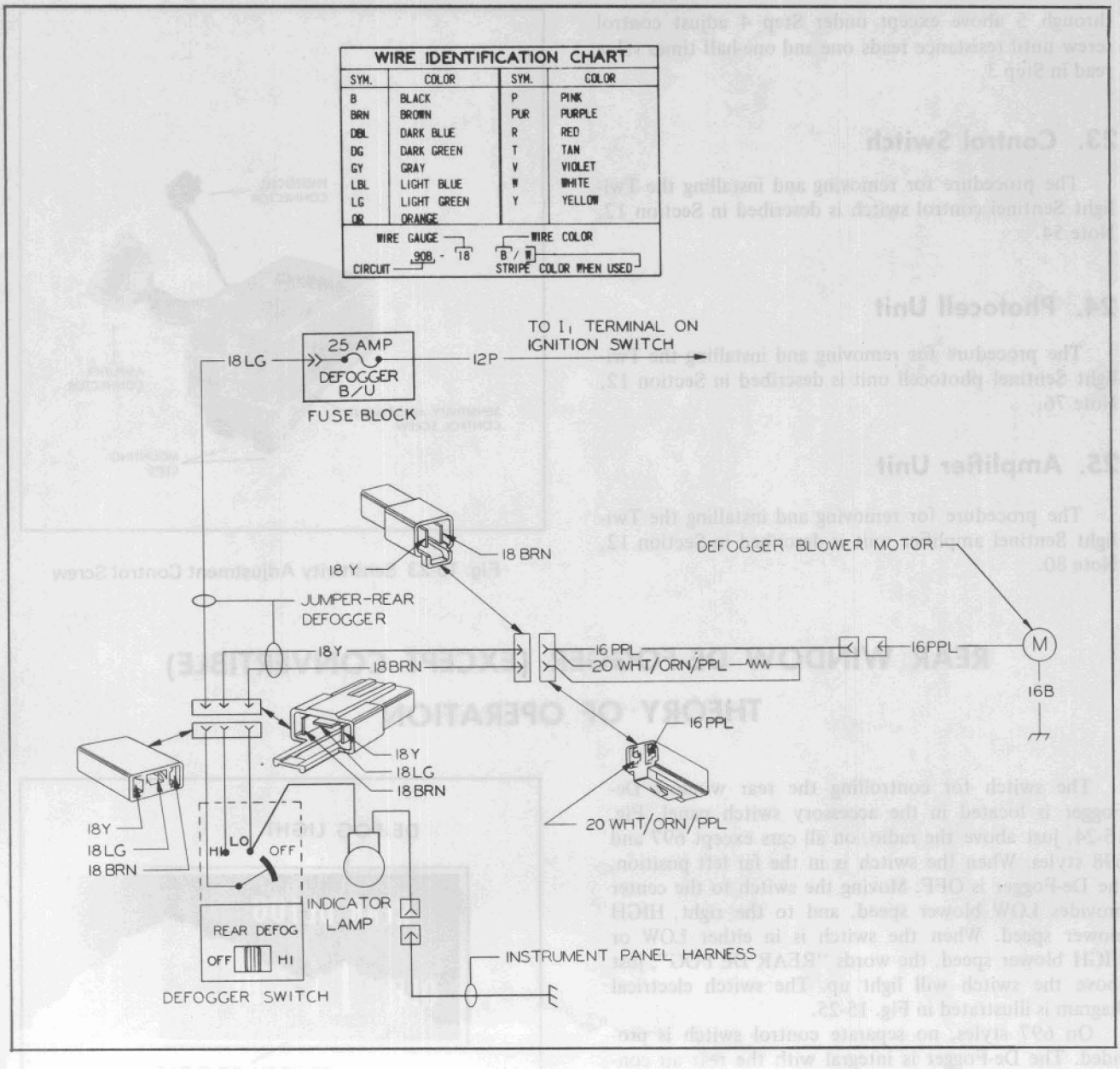


Fig. 15-25 Rear De-Fogger Circuit Diagram (Except Convertible)

lines. When the grid lines are subjected to current flow, they heat the glass and remove fog from the glass surface.

A green indicator light in the switch is illuminated whenever the De-Fogger is operating. When the switch is pulsed on, the relay allows current to flow for approximately ten minutes, then shuts off. Additional periods of heating operation can be obtained each time the switch is pulsed on. Pulsing the switch "ON" while the De-Fogger is in operation will not extend the heating period beyond the normal delay cycle. The De-Fogger must shut itself off before it can be re-energized. The De-Fogger can be manually shut off at anytime during its time delay cycle; by momentarily moving the control switch to the "OFF" position. Turning off the ignition switch also turns off the De-Fogger.

DIAGNOSIS (EXCEPT CONVERTIBLE)

26. De-Fogger Switch Test

1. Disconnect De-Fogger switch jumper connector at fuse panel (light green wire). Turn ignition on but do not start engine. Touch one lead of non-powered test lamp to ACC terminal on fuse panel and other to ground; lamp should light. If it does not, difficulty is in wiring to fuse panel or a blown fuse. If it does light,

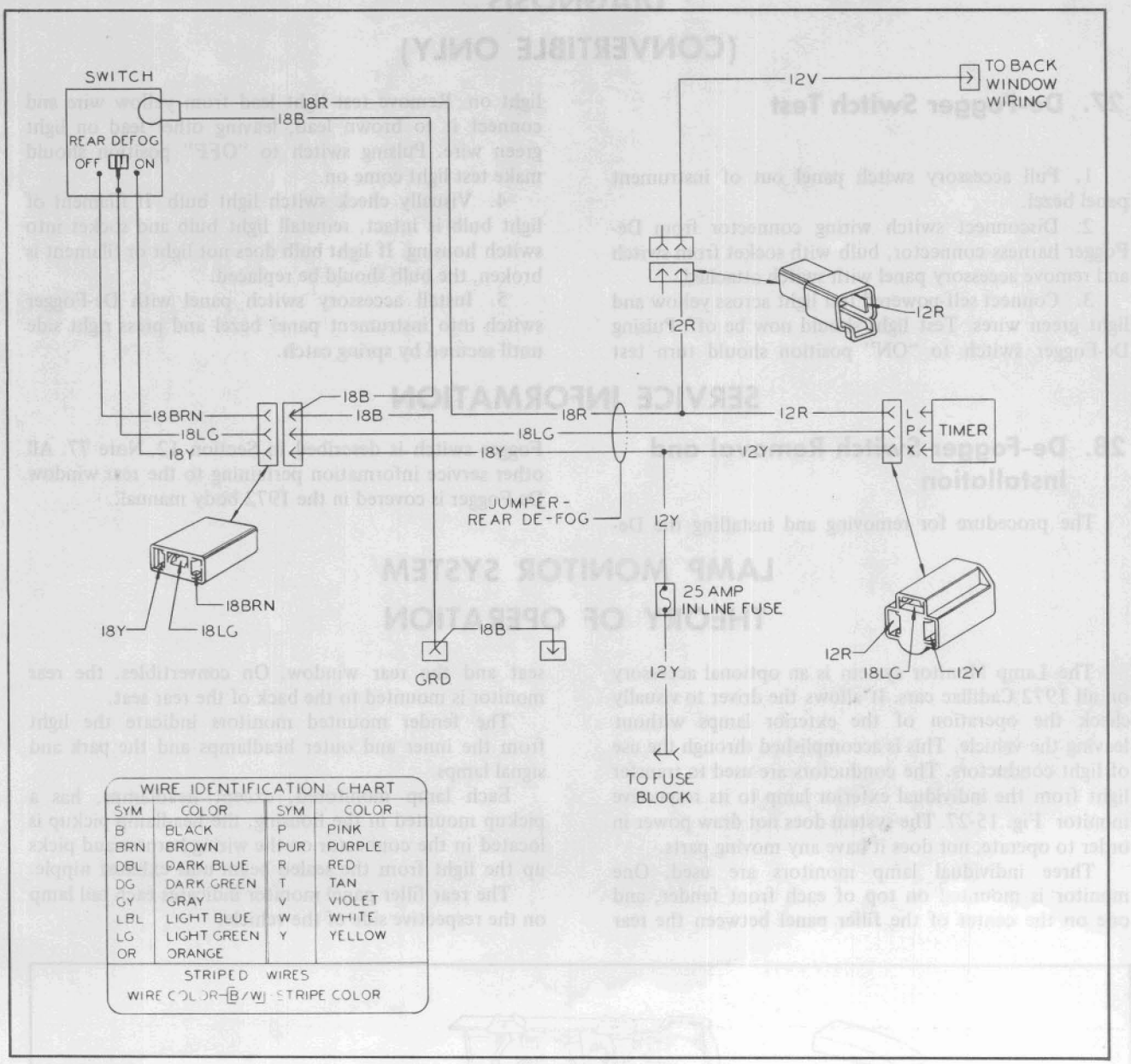


Fig. 15-26 Rear De-Fogger Circuit Diagram (Convertible only)

connect De-Fogger connector at fuse panel and proceed with check. Turn ignition off.

2. Remove De-Fogger switch as described in Section 12, Note 77a.

3. Using a self powered test light, check switch as follows:

a. Touch one lead of test light to green wire and the other lead to yellow wire. Test light should glow only in "HI" position.

b. Touch one lead of test lamp to green wire and other lead to brown wire. Test light should glow in the "LOW" and in the "HI" position.

c. To check bulb circuit, touch one lead of test light to brown wire and other lead to black wire. Bulb should glow in all positions.

d. If no defect is found in switch, connect wiring connector and reinstall switch as described in Section 12, Note 77b.

4. If switch does not check as described above, replace switch.

DIAGNOSIS
(CONVERTIBLE ONLY)

27. De-Fogger Switch Test

1. Pull accessory switch panel out of instrument panel bezel.

2. Disconnect switch wiring connector from De-Fogger harness connector, bulb with socket from switch and remove accessory panel with switch attached.

3. Connect self-powered test light across yellow and light green wires. Test light should now be off. Pulsing De-Fogger switch to "ON" position should turn test light on. Remove test light lead from yellow wire and connect it to brown lead, leaving other lead on light green wire. Pulsing switch to "OFF" position should make test light come on.

4. Visually check switch light bulb. If filament of light bulb is intact, reinstall light bulb and socket into switch housing. If light bulb does not light or filament is broken, the bulb should be replaced.

5. Install accessory switch panel with De-Fogger switch into instrument panel bezel and press right side until secured by spring catch.

SERVICE INFORMATION

28. De-Fogger Switch Removal and Installation

The procedure for removing and installing the De-Fogger switch is described in Section 12, Note 77. All other service information pertaining to the rear window De-Fogger is covered in the 1972 body manual.

LAMP MONITOR SYSTEM
THEORY OF OPERATION

The Lamp Monitor system is an optional accessory on all 1972 Cadillac cars. It allows the driver to visually check the operation of the exterior lamps without leaving the vehicle. This is accomplished through the use of light conductors. The conductors are used to transfer light from the individual exterior lamp to its respective monitor Fig. 15-27. The system does not draw power in order to operate, nor does it have any moving parts.

Three individual lamp monitors are used. One monitor is mounted on top of each front fender, and one on the center of the filler panel between the rear seat and the rear window. On convertibles, the rear monitor is mounted to the back of the rear seat.

The fender mounted monitors indicate the light from the inner and outer headlamps and the park and signal lamps.

Each lamp monitored, except headlamps, has a pickup mounted in the housing; the headlamp pickup is located in the connector on the wiring harness and picks up the light from the sealed beam unit exhaust nipple.

The rear filler panel monitor indicates each tail lamp on the respective side of the vehicle.

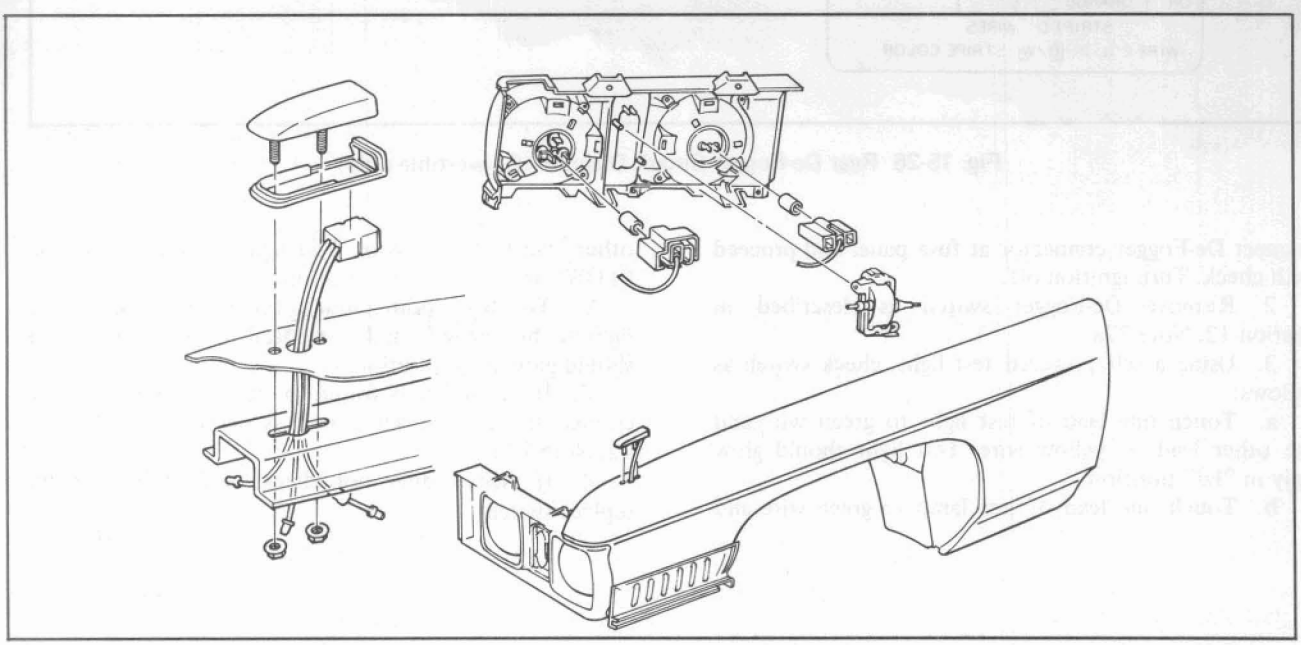


Fig. 15-27 Lamp Monitoring System

LAMP MONITOR SYSTEM DIAGNOSIS

29. Monitor Inoperative

1. Check bulb in lamp connected to inoperative monitor.
2. If bulb is burned out, replace bulb. If lamp operates normally, proceed with further checks.
3. Check for proper installation of conductors to sealed beam or lamp housing as required. If correct, proceed to Step 4.
4. Check conductor harness mounting to lamp monitors for proper attachment.
5. Check conductor harness routing for pinched or severly bent condition.
6. If none of the above checks reveals the inoperative condition, the conductor light fibers have probably been damaged. Replace conductors as required.

SERVICE INFORMATION

30. Front Monitor Harness

a. Removal

1. Open hood.
2. Disconnect conductor harness from front lamps.
3. Reach under fender and remove two nuts from read-out mounting studs and remove read-out housing from top of fender.
4. Remove read-out connector with conductor harness by pulling out through hole in top of fender.

b. Installation

1. Install lamp end of conductors down through hole in top of fender.
2. Route harness and install conductor ends into respective lamps.
3. Fit read-out housing over harness connector and secure to fender with two nuts.
4. Check operation of read-out. If satisfactory, close hood. If not, check installation and routing.

31. Rear Monitor Harness Removal and Installation

a. Removal

1. Open rear deck lid.
2. Loosen rear bumper and separate from body as far as possible.
3. Reach under bumper and remove conductors from lamps by pulling straight out.
4. Working through trunk compartment, remove conductor grommet from rear of trunk on 693 styles and pull conductor into trunk. On "C" car, remove trunk side trim panels.
5. Working in trunk compartment, remove two nuts securing read-out housing to rear filler panel. Remove read-out from rear passenger compartment by pulling conductor harness up through filler panel.
6. If car being worked on is a convertible, remove two screws securing read-out housing to back of rear seat from passenger compartment and remove harness.

b. Installation

1. If car being worked on is a convertible, route harness behind rear seat from passenger compartment and secure read-out housing to back of rear seat with two screws.
2. On all other cars, feed lamp end of harness down through filler panel from passenger compartment. Position read-out housing to filler panel.
3. Working in trunk compartment, secure read-out housing to filler panel with two nuts.
4. Route conductor harness through trunk compartment behind side trim panels on "C" cars. Install side trim panels. On 693 styles, route through holes in rear of trunk compartment and seal with grommets.
5. Reach under bumper and install conductors into respective lamps.
6. Align bumper and tighten.
7. Check operation of monitor. If satisfactory, close deck lid. If not, check, installation and routing.

(NOTE: For additional information pertaining to the Lamp Monitor system, refer to the 1972 body manual.)

WASHER FLUID LOW LEVEL INDICATOR GENERAL DESCRIPTION

A washer fluid low level indicator light is provided on cars equipped with the Lamp Monitor accessory. The light is located on the left side of the instrument cluster below the left turn indicator light. It is labeled "WASHER FLUID" and it glows amber when the fluid level in the windshield washer bottle drops below approximately 1/3 full.

Engaging the wipers allows a small amount of current to flow from the wiper motor terminal through a #18 yellow wire to the washer bottle float unit, Fig. 15-28. When the fluid level in the washer bottle is low, the float drops, allowing the circular magnet to separate from the cap assembly, Fig. 15-29. This permits the contact points within the cap to close, bypassing the resistor that is in parallel with the contact points, and causing current to flow to the indicator light.

The indicator system operates in conjunction with the windshield wiper motor. A low fluid level condition

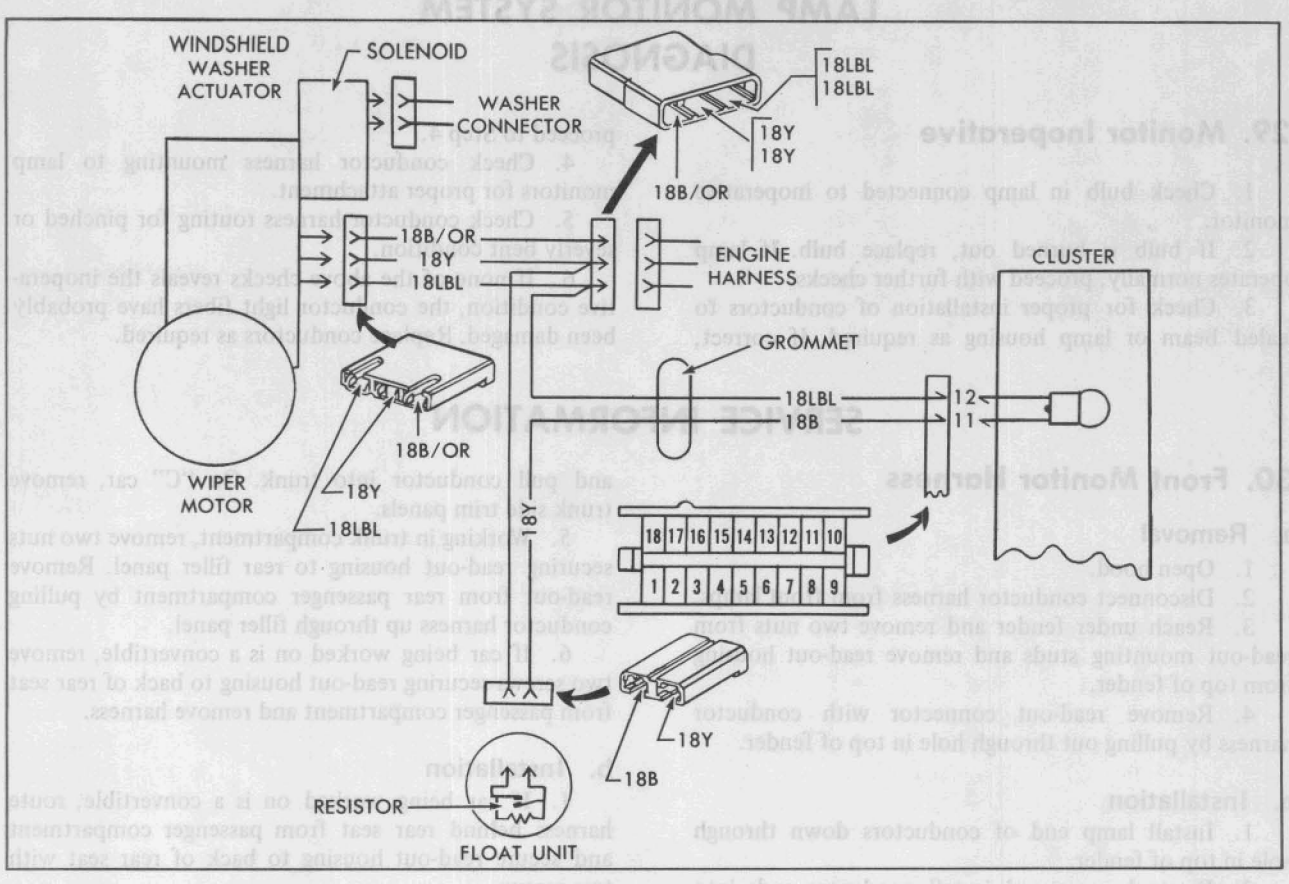


Fig. 15-28 Washer Fluid Indicator Circuit Diagram

will not be indicated to the driver unless the windshield wipers are running.

The complete float and cap unit must be replaced if defective.

CAUTION: Use care when handling the float assembly, as the switch is sealed air-tight in glass and can be broken if subjected to a hard impact.

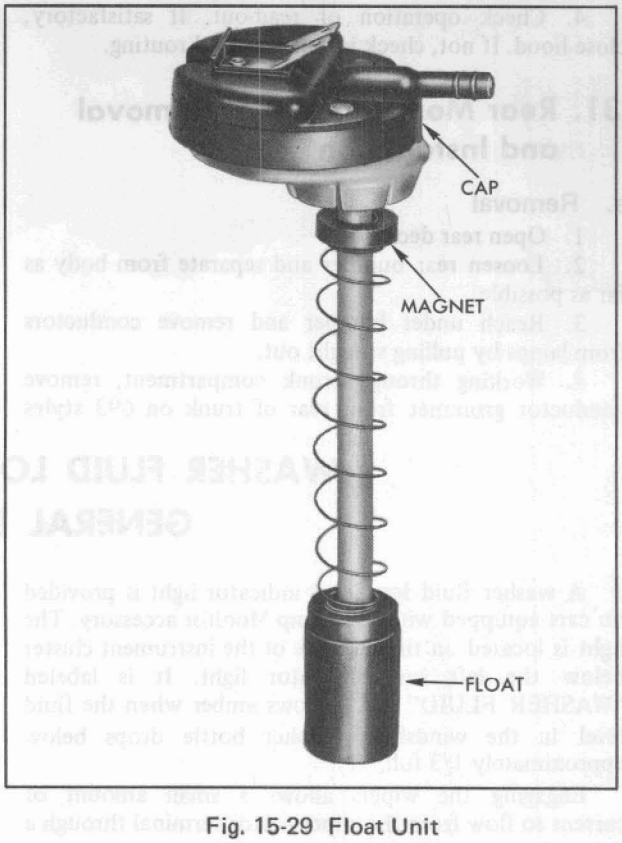


Fig. 15-29 Float Unit

DIAGNOSIS

32. Indicator Inoperative

1. Turn windshield wipers on. Indicator will not operate unless wipers are running.
2. Open hood and remove float and cap assembly from washer bottle. Float should move to bottom of stem and magnet should separate from cap; if not, replace float and cap assembly.
3. Examine cap to be sure that switch is intact and glass seal is not broken. If damage is evidenced, replace float and cap assembly.
4. Check electrical connections at cap.
5. Replace bulb in instrument cluster.

SUNROOF
THEORY OF OPERATION

An electrically-operated motor-driven Sunroof, Figs. 15-30 and 15-31 is available as an optional feature on the Cadillac Coupe de Ville, Sedan de Ville, Fleetwood Sixty Special Brougham and Eldorado Coupe, when equipped with vinyl roofs; and is also provided on Eldorados with the Custom Cabriolet option. The Sunroof permits opening of a sliding roof panel to admit sunshine and outside air into the passenger compartment.

Operation

The Sunroof is operated by a two-position switch labeled "SUN ROOF", Fig. 15-32, located on the right side of the instrument cluster just above the radio. To open roof panel, with ignition ON, the control switch is moved to the right, toward the letters "OPN". The roof panel then retracts down and rearward, moving on guide rails, Fig. 15-31, from the flush roof position back into a storage space between the headlining and the roof. To close the roof panel, the switch is moved to the left, toward the letters "CLS". The panel then moves forward in the guide rails and, as it nears the end of forward travel, the rear portion moves upward on two ramps, Fig. 15-31. This positions the panel flush with the roof and seals it tightly in the opening.

The Sunroof can be left partially open by releasing the control switch at any position in either direction of its travel.

Manual Operation

The Sunroof can be closed manually in the event it should fail to close when the control switch is moved to the "CLS" position. To do this, remove the small round plug located in the center of the headlining near the front edge of the roof opening to gain access to the winding gear. Remove the plug by grasping with fingers and pulling outward. Fig. 15-33. Remove the screw (visible when plug is removed) using bladed end of crank handle provided in glove box.

CAUTION: Observe the number and type of washers removed with the screw. The screw and washers provide adjustment for the auxiliary drive clutch.

Insert the threaded end of crank handle into the socket in the winding gear, Fig. 15-34. Turn crank handle clockwise to close the roof. Remove the crank handle, install the screw with washers in their proper order, and tighten the screw securely, then replace the round plug.

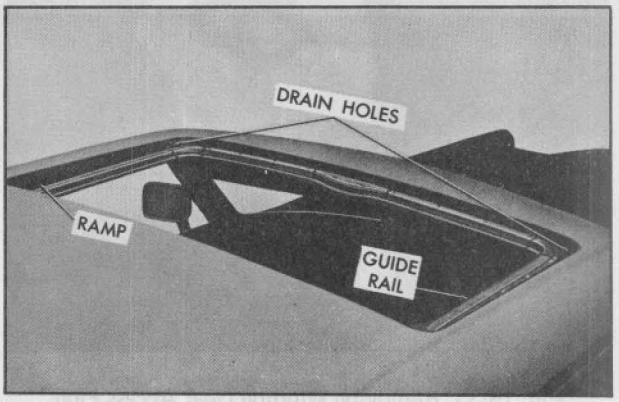


Fig. 15-31 Sunroof Fully Opened

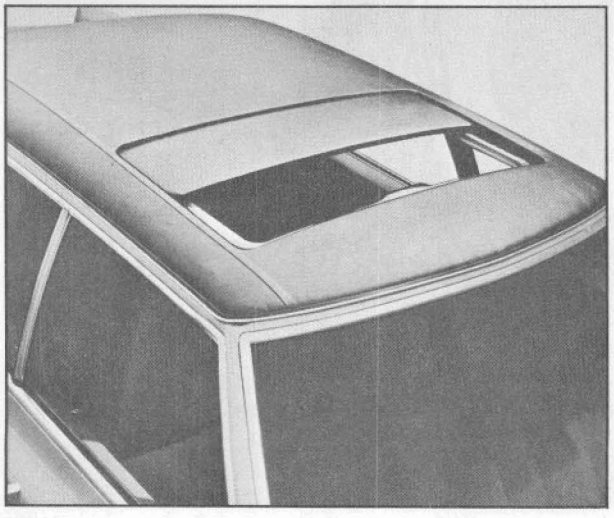


Fig. 15-30 Sunroof Partially Opened

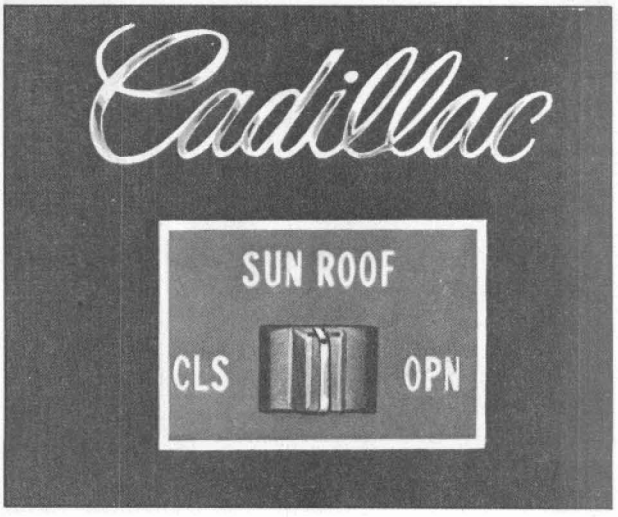


Fig. 15-32 Control Switch

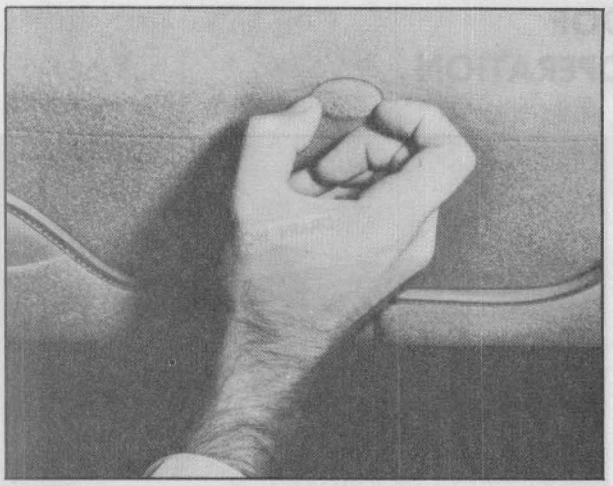


Fig. 15-33 Removing Winding Gear Access Plug

(NOTE: The crank handle can be used only to close the roof.)

Design and Construction Features

The Sunroof is actuated by a two-way electric motor mounted near the center of the windshield header area, Fig. 15-35. The motor drives an auxiliary unit with a gear on the output shaft. This gear, in turn, drives two flexible gear cables that are attached to the roof panel and control its movement, Fig. 15-36.

Four plastic drain tubes, two on each side, are incorporated in the windshield pillar area and in the rear quarter area to catch water seepage that may bypass the weatherstrip seal around the roof opening. The two forward tubes, Fig. 15-37, are routed from the roof panel trough down through the right and left windshield pillars, and out through the rocker panels. The rear drain tubes are routed through the rear quarter panel and drain through the rear wheel housings.

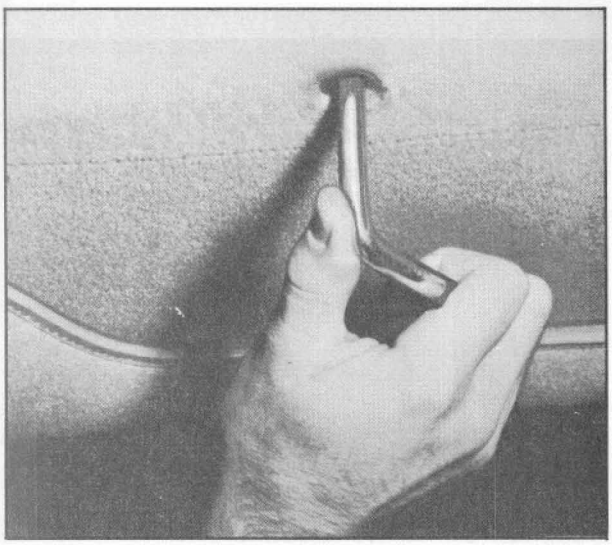


Fig. 15-34 Closing Sunroof With Crank Handle

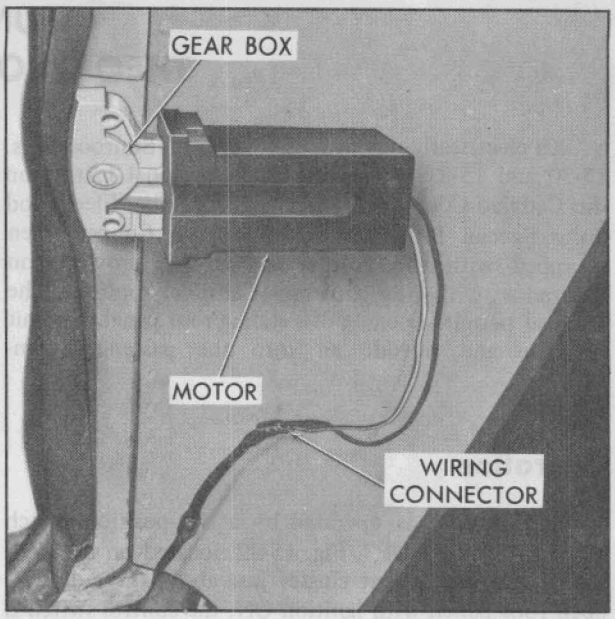


Fig. 15-35 Motor and Drive Unit Location

Electrical System

The electrical circuit for the Sunroof is protected by a 25-amp circuit breaker located on the instrument panel center brace underneath the instrument panel top cover.

Electrical power for the system, Fig. 15-38, is supplied from the fuse block through a pink wire to the 25-amp circuit breaker. Another pink wire is routed from the circuit breaker to a three-way connector that leads to the control switch on the instrument panel. An orange and black feed wire leads to the switch. Two wires--black for the open cycle and light green for the close cycle--are routed from the switch to the motor.

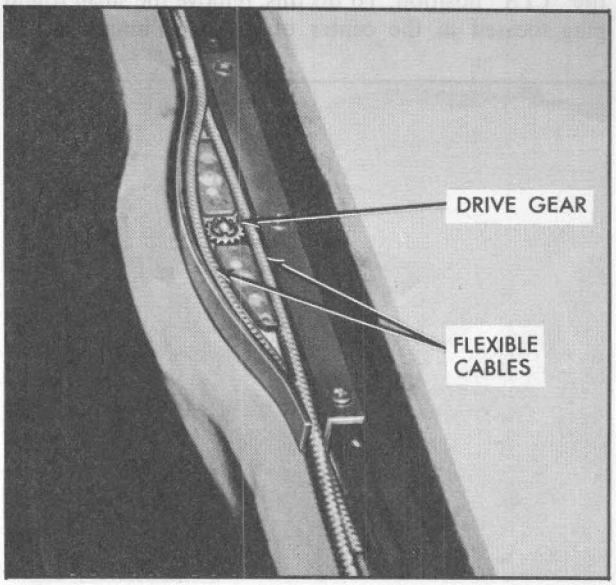


Fig. 15-36 Drive Gear and Cables

DIAGNOSIS

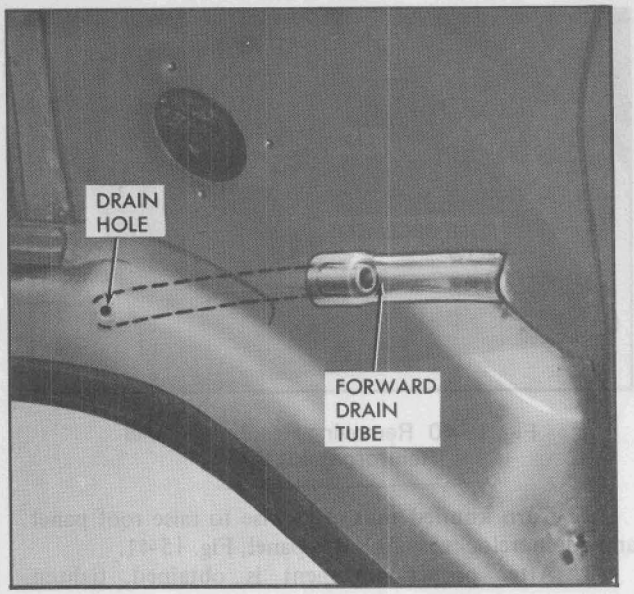


Fig. 15-37 Forward Drain Tube-Left Side

33. Diagnosis of Inoperative Panel

1. Motor runs, panel fails to rise.

a. Panel does not run true due to mechanical resistance; see Note 35d, Panel Does Not Run True, and Note 35e, Cable Guide Alignment. Drive cables may be disconnected or broken.

b. Front slides are tilted and require alignment; see Note 35a, Panel Alignment.

c. Check alignment of ramp and lifting elements; see Note 35c, Ramp Alignment.

(1) Remove winding gear access plug, Fig. 15-33.

(2) Unscrew slotted-head screw, and add another washer (shim) to those already in position.

(NOTE: Special washers are listed in the parts catalogue, under Group 14.560.)

(3) Replace screw and check operation.

(4) Tighten slotted-head screw securely.

2. Motor Fails to Run (Fig. 15-38).

a. Check continuity of circuit breaker and wiring connector at control switch.

b. Check control switch to assure electrical continuity to motor.

c. Check wiring and connections to motor. Check motor ground wire.

d. Replace motor.

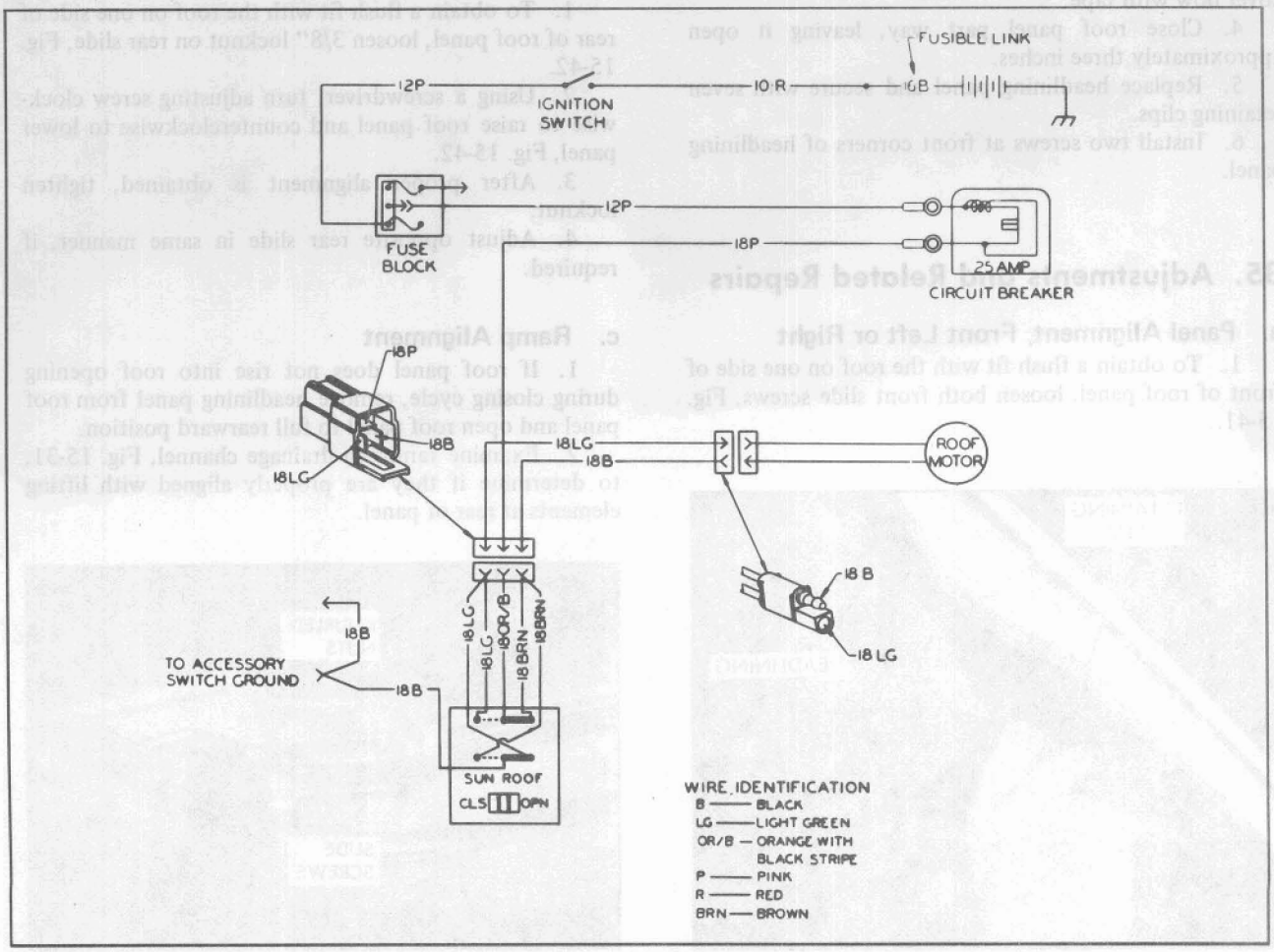


Fig. 15-38 Sunroof Circuit Diagram

SERVICE INFORMATION

34. Headlining Panel

a. Removal

1. Open roof panel approximately three inches.
2. Remove two screws securing headlining panel to roof panel at front corners.
3. Slide headlining panel forward and out of seven retaining clips mounted on roof panel front edge, Fig. 15-39.
4. Retract roof panel to full open position.
5. Remove headlining panel reinforcement bow from headlining by removing tape from bow and sliding bow rearward and off the headlining material, Fig. 15-40.
6. Close roof panel approximately three inches to permit rear of headlining frame to fall clear of roof panel rear hooks.
7. Grasp headlining panel front edge and pull it forward and out of side guide rail lower tracks.

b. Installation

1. Retract roof panel to full open position.
2. Align headlining panel with side guide rail lower tracks and move rearward into proper position.
3. Install reinforcement bow on headlining and cover bow with tape.
4. Close roof panel part way, leaving it open approximately three inches.
5. Replace headlining panel and secure with seven retaining clips.
6. Install two screws at front corners of headlining panel.

35. Adjustments and Related Repairs

a. Panel Alignment, Front Left or Right

1. To obtain a flush fit with the roof on one side of front of roof panel, loosen both front slide screws, Fig. 15-41.

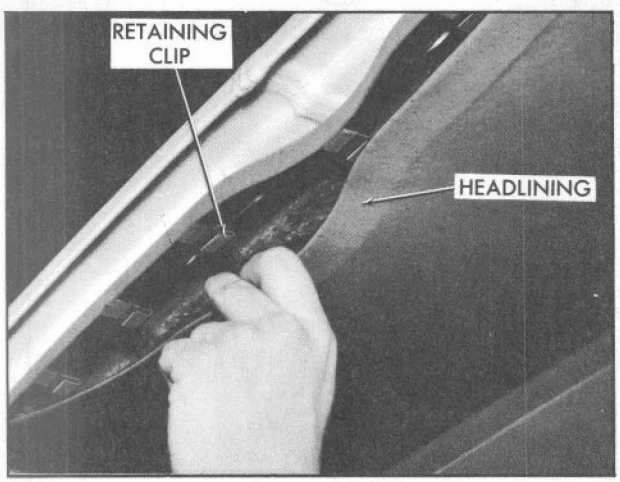


Fig. 15-39 Headlining Panel Removal

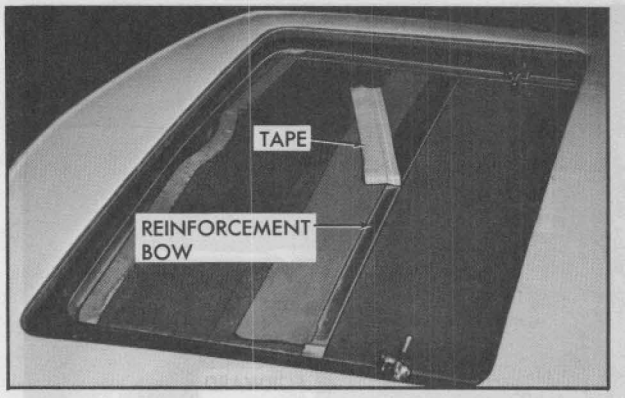


Fig. 15-40 Removing Headlining Panel Reinforcement Bow

2. Turn knurled nuts clockwise to raise roof panel and counterclockwise to lower panel, Fig. 15-41.
3. After proper alignment is obtained, tighten screws.
4. Adjust opposite front slide in same manner if required.

b. Panel Alignment, Rear Left or Right

1. To obtain a flush fit with the roof on one side of rear of roof panel, loosen 3/8" locknut on rear slide, Fig. 15-42.
2. Using a screwdriver, turn adjusting screw clockwise to raise roof panel and counterclockwise to lower panel, Fig. 15-42.
3. After proper alignment is obtained, tighten locknut.
4. Adjust opposite rear slide in same manner, if required.

c. Ramp Alignment

1. If roof panel does not rise into roof opening during closing cycle, remove headlining panel from roof panel and open roof panel to full rearward position.
2. Examine ramps in drainage channel, Fig. 15-31, to determine if they are properly aligned with lifting elements at rear of panel.

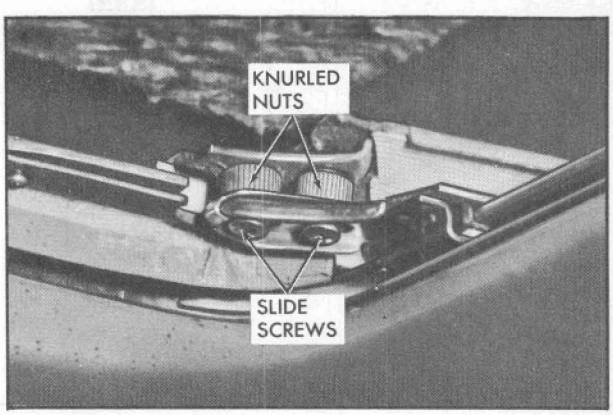


Fig. 15-41 Front Panel Alignment

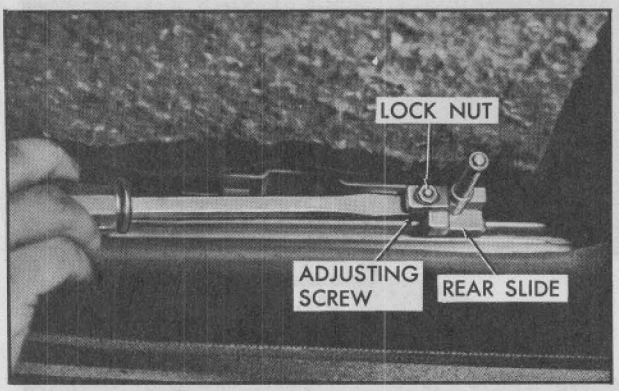


Fig. 15-42 Rear Panel Alignment

(NOTE: The point where lifting element makes contact with ramp can be seen on rearward slope of ramp.)

3. Using a screwdriver or similar tool, pry ramp up and move ramp side to side until it is centered with lifting element.

4. Close roof panel and note lifting action of panel.

5. If necessary, readjust ramps up or down and side to side, until proper lifting action of roof panel is obtained.

d. Panel Does Not Run True

1. Close roof panel to determine which side of panel jams.

2. WARNING: THE CLIP IS MADE OF SPRING STEEL. HOLD HAND OVER CLIP WHEN REMOVING TO PREVENT RAPID SPRING-UP WHEN PERFORMING THIS STEP.

Open roof panel, remove drive housing center cover and pry off drive cable retaining clip, Fig. 15-43.

3. To move right hand side of roof panel forward, lift right cable at front of pinion and pull it one or more teeth to the left.

4. Install retaining clip and drive housing cover and check operation.

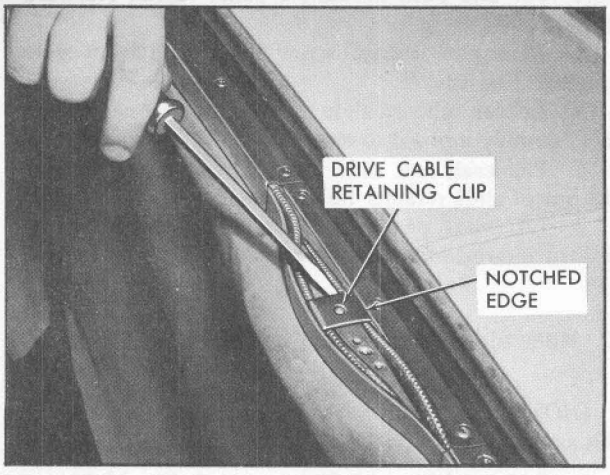


Fig. 15-43 Removing Drive Cable Retaining Clip

5. To move left hand side of roof panel forward, perform similar operation on left cable.

(NOTE: Do not move panel while cable is off pinion.)

e. Cable Guide Alignment

1. If roof panel jams during its travel, check both front corner lower elbow guides for alignment with front and side guides.

2. If necessary, shim lower elbow guides to move guides inboard for alignment with adjacent guides.

3. If panel fails to rise, the joints of cable slides are out of alignment (guide rail, corner and connector guides, and cable drive housing) and are jamming cable drive.

a. Loosen screws retaining the guide rails, corner and connector rails, and cable drive housing a few turns.

b. Retighten the screws one by one, continually activating the drive mechanism.

c. Where necessary, realign those points where resistance is felt.

36. Control Switch

a. Removal

1. Pull instrument panel insert out of bezel, Fig. 15-32.

2. Disconnect electrical feed wires from wiring harness.

3. Remove one screw and remove switch.

b. Installation

1. Install switch in instrument panel insert and secure with one screw.

2. Connect electrical connectors to instrument panel wiring harness.

3. Install instrument panel insert into bezel and press right side until secured by spring catch.

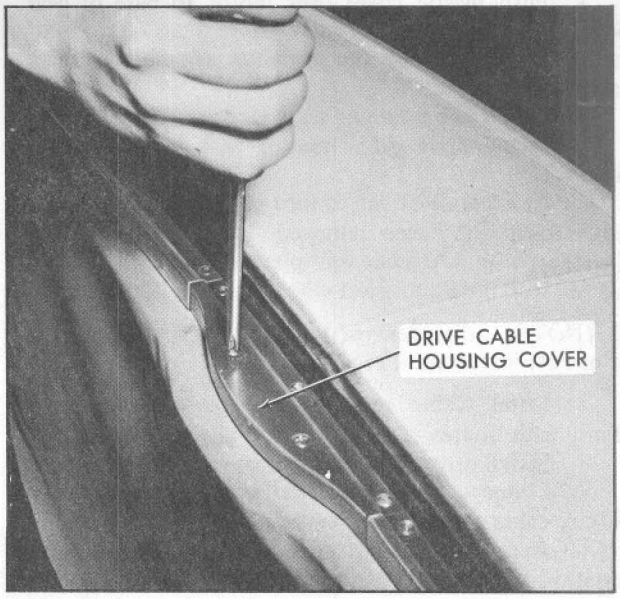


Fig. 15-44 Removing Drive Cable Housing Cover

37. Motor and Gear Box Assembly

a. Removal

1. Open Sunroof to three-quarter full open position.
2. Disconnect negative battery cable.
3. Remove left and right windshield side garnish moldings, roof side rail garnish moldings, both sun visor assemblies, and center sun visor bracket.
4. Remove left and right windshield upper garnish moldings.
5. Carefully pull headlining from front roof inner panel at top of windshield area sufficiently to gain access to Sunroof motor and gear box assembly, Fig. 15-35.
6. Remove foam insulation padding in front of roof panel opening adjacent to motor and gear box assembly.
7. Disconnect motor electrical wiring connector.
8. Remove drive cable housing cover, Fig. 15-44.
9. Remove left and right elbow corner guides.

WARNING: THE CLIP IS MADE OF SPRING STEEL. HOLD HAND OVER CLIP WHEN REMOVING TO PREVENT RAPID SPRING-UP WHEN PERFORMING THIS STEP.

10. Using a small screwdriver, carefully pry up drive cable retaining clip, Fig. 15-43.
11. Pull drive cables out of upper and lower front guides, observing routing of cables in guides for installation purposes.
12. Remove three screws retaining drive cable housing and remove housing.
13. From top area, remove two gear box assembly retaining screws and remove gear box assembly with motor.

b. Installation

1. Push plastic cover over motor to base of gear box.
2. Position motor and gear box assembly in drive cable housing.
3. Install two retaining screws.
4. Install drive cable housing with three retaining screws.
5. Insert ends of cables into guides, observing same cable routing as when removed. Lubricate cables and drive gear with #70 grade lubriplate or equivalent.
6. Install right and left elbow corner guides.

(NOTE: Alignment of lower elbow corner guide is of utmost importance, Fig. 15-45.)

7. Install cable retaining clip by pressing down firmly with thumb.
8. Install drive cable housing cover.
9. Connect motor electrical wiring connector and battery cable, and check operation of system.
10. Apply cement to foam insulation padding and install padding.
11. Apply trim cement sparingly to forward edge of roof panel. Starting at center, position headlining to front roof inner panel forward edge. Smooth out all wrinkles, working from center to outboard ends.
12. Install roof side rail garnish moldings, windshield upper and side garnish moldings, center sun visor bracket, and sun visors.

CAUTION: Be careful not to pinch drain tubes when installing windshield side garnish moldings.

13. Close Sunroof.

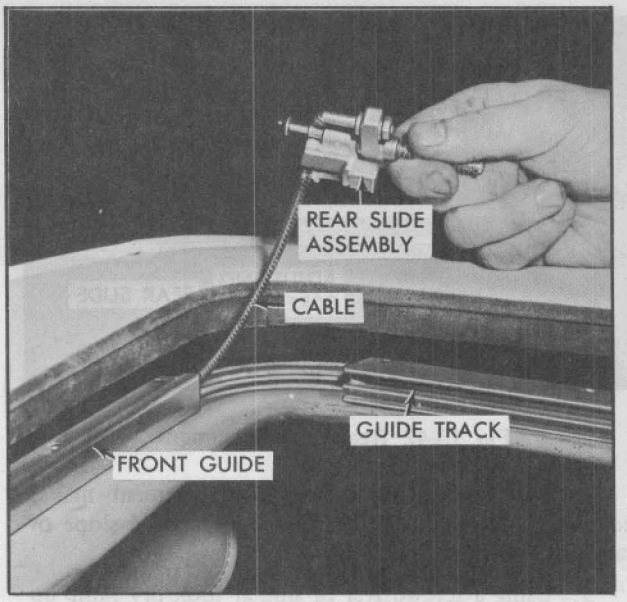


Fig. 15-45 Removing Rear Slide and Cable

38. Sunroof Panel, Rear Slide, and Cable (Fig. 15-46)

a. Sunroof Panel Removal

1. Open Sunroof approximately three inches.
2. Remove two screws from front of headlining panel that secure headlining to roof panel.
3. Slide headlining panel forward and out of seven retaining clips on roof panel front edge, Fig. 15-39. Close roof and push headlining panel to full rearward position.
4. Remove outboard screw from each front slide assembly, Fig. 15-47.
5. Loosen inboard slide screw and rotate each front slide assembly inboard to clear guide rail, Fig. 15-48.
6. Pull each rear slide and cable assembly inboard and out of slide retainer hole in roof panel, Fig. 15-49.
7. Lift roof panel at front edge and pull panel forward and out of roof opening.

b. Rear Slide and Cable Removal

(NOTE: If only one cable is defective, replace both. This assures parallel travel of roof panel.)

1. Remove drive cable housing cover, Fig. 15-44.
2. Remove both front upper elbow guides.

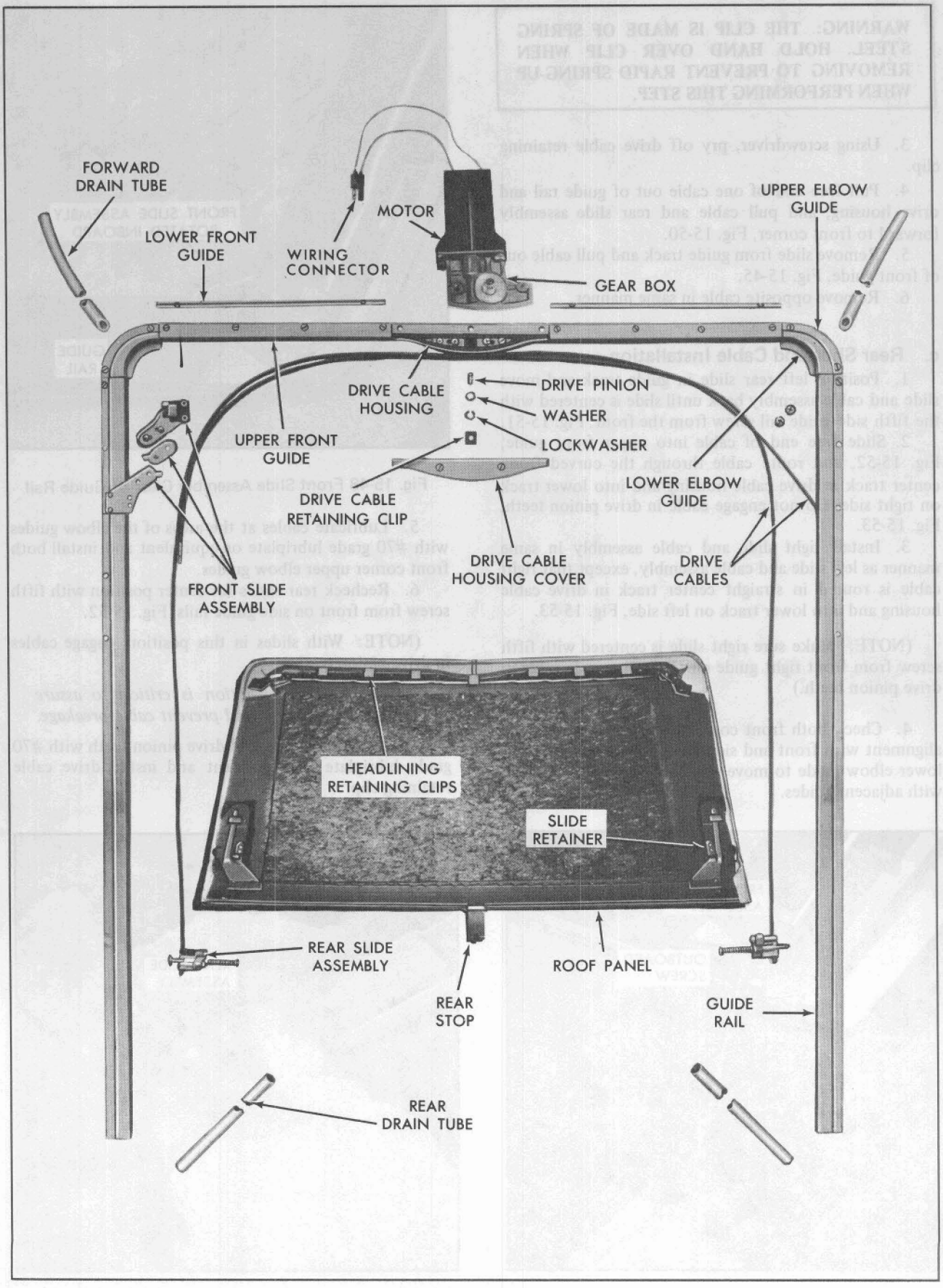


Fig. 15-46 Roof Panel Disassembled

WARNING: THE CLIP IS MADE OF SPRING STEEL. HOLD HAND OVER CLIP WHEN REMOVING TO PREVENT RAPID SPRING-UP WHEN PERFORMING THIS STEP.

3. Using screwdriver, pry off drive cable retaining clip.

4. Pull free end of one cable out of guide rail and drive housing, and pull cable and rear slide assembly forward to front corner, Fig. 15-50.

5. Remove slide from guide track and pull cable out of front guide, Fig. 15-45.

6. Remove opposite cable in same manner.

c. Rear Slide and Cable Installation

1. Position left rear slide in guide track and move slide and cable assembly back until slide is centered with the fifth side guide rail screw from the front, Fig. 15-51.

2. Slide free end of cable into upper front guide, Fig. 15-52, and route cable through the curved front center track in drive cable housing and into lower track on right side. Do not engage cable in drive pinion teeth, Fig. 15-53.

3. Install right slide and cable assembly in same manner as left slide and cable assembly, except that right cable is routed in straight center track in drive cable housing and into lower track on left side, Fig. 15-53.

(NOTE: Make sure right slide is centered with fifth screw from front right guide rail. Do not engage cable in drive pinion teeth.)

4. Check both front corner lower elbow guides for alignment with front and side guides. If necessary, shim lower elbow guide to move guide inboard for alignment with adjacent guides.

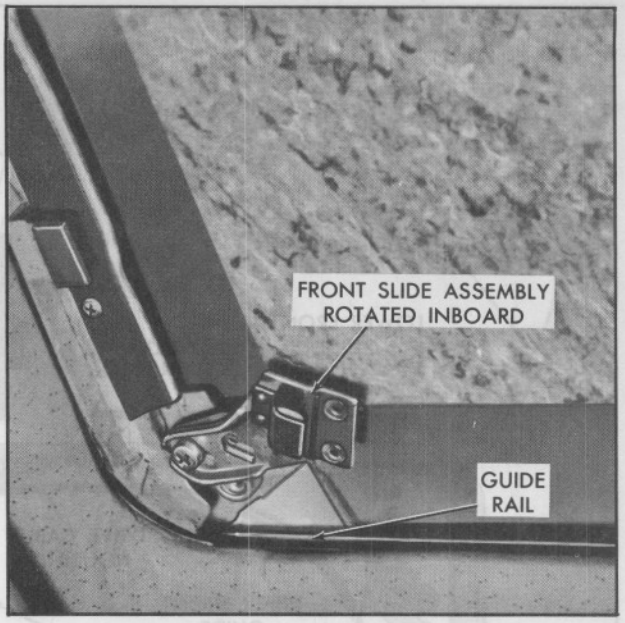


Fig. 15-48 Front Slide Assembly Clear of Guide Rail

5. Lubricate cables at the areas of the elbow guides with #70 grade lubriplate or equivalent and install both front corner upper elbow guides.

6. Recheck rear slides for center position with fifth screw from front on side guide rails, Fig. 15-52.

(NOTE: With slides in this position, engage cables in drive pinion teeth.)

CAUTION: This operation is critical to assure roof panel alignment and prevent cable breakage.

7. Lubricate cables and drive pinion teeth with #70 grade lubriplate or equivalent and install drive cable retaining clip.

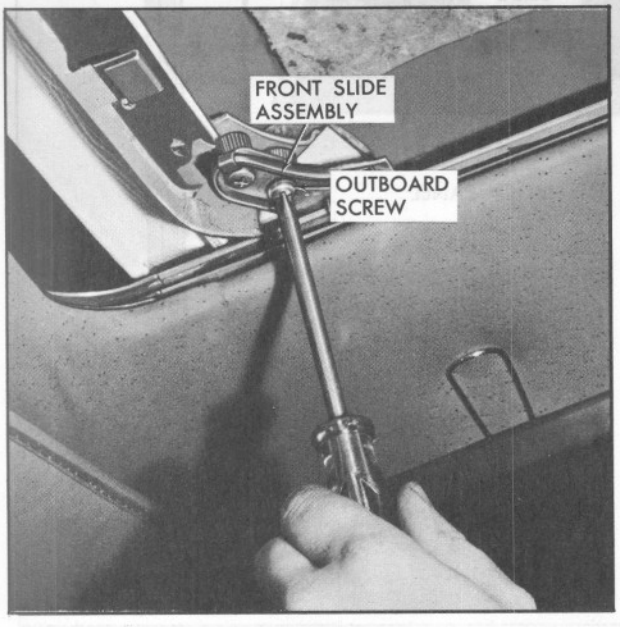


Fig. 15-47 Removing Outboard Screw From Front Slide Assembly

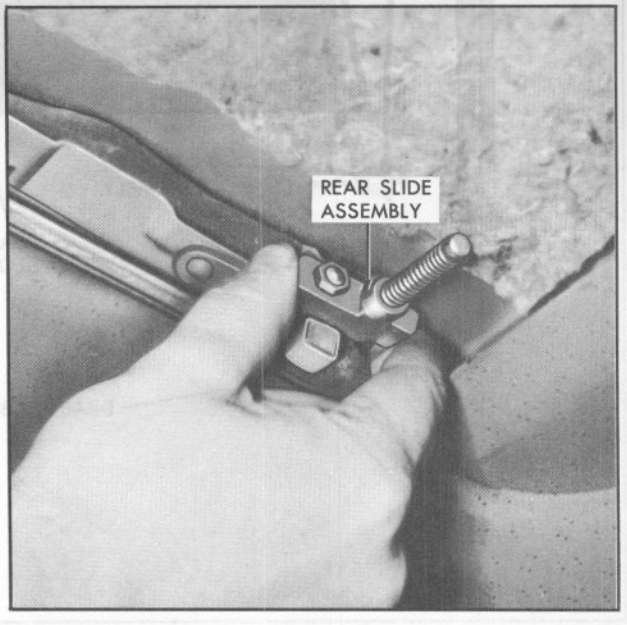


Fig. 15-49 Removing Rear Slide and Cable Assembly From Retainer

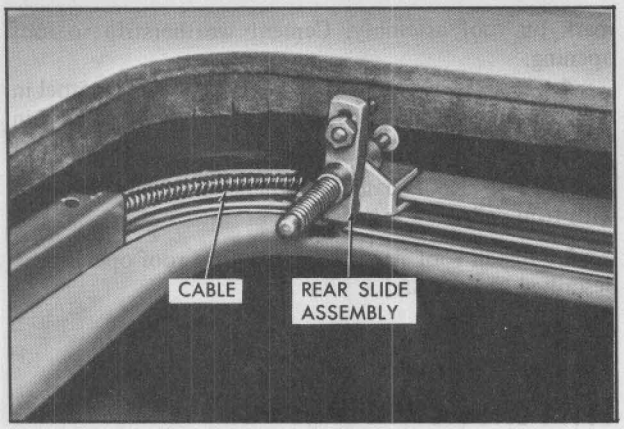


Fig. 15-50 Cable and Slide Assembly Pulled Forward

(NOTE: Narrow (notched) edge of clip is positioned toward front of vehicle.)

8. Install drive cable housing cover, being careful not to overtighten screws.

9. Actuate switch to check cable operation, then return rear slides to fifth screw from front on side guide rails.

d. Roof Panel Installation

1. With headlining panel in full rearward position, install roof panel into roof opening.

CAUTION: Hold roof panel in a nearly horizontal position when placing panel into roof opening to assure that stop on center rear edge of roof panel does not damage passenger compartment headlining.

2. Move each front slide assembly outboard and install slides on guide rail upper tracks.

3. Install outboard screws and tighten both screws on each slide, Fig. 15-41.

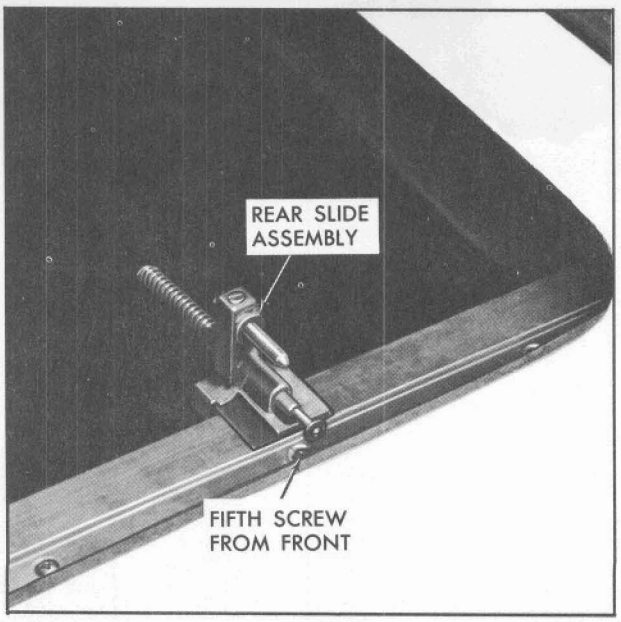


Fig. 15-51 Rear Slide In Centered Position

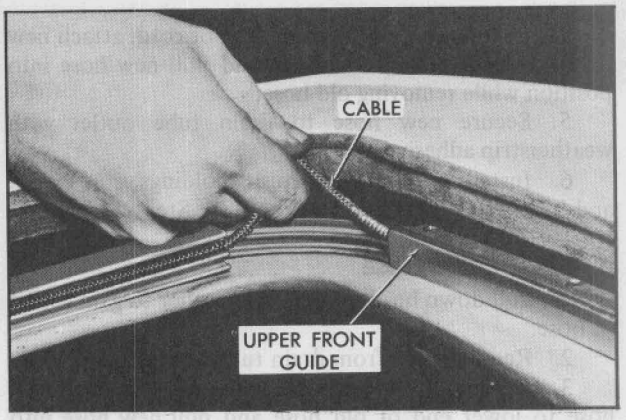


Fig. 15-52 Installing Cable Into Upper Front Guide

4. Push roof panel to full forward position by hand.

5. Lift rear of roof panel upward and actuate control switch to position rear slides into alignment with holes on slide retainers on roof panel, Fig. 15-49.

6. Engage each rear slide pin into retainer hole and install retainer spring plate on slide pin.

7. Actuate switch, check operation of roof panel, and note fit of panel to roof. If any adjustments are necessary, refer to Note 35.

8. Install headlining on roof panel.

39. Drain Hose Replacement

a. Front Drain Hose

1. Perform Steps 3, 4, and 5, in Note 37a, and carefully pull headlining away from top of windshield area sufficiently to gain access to either front drain hose, Fig. 15-37.

2. Remove kick pad trim panel.

3. Remove hose from drain tube outlet at top.

(NOTE: Adhesive is used to secure hose to outlet.)

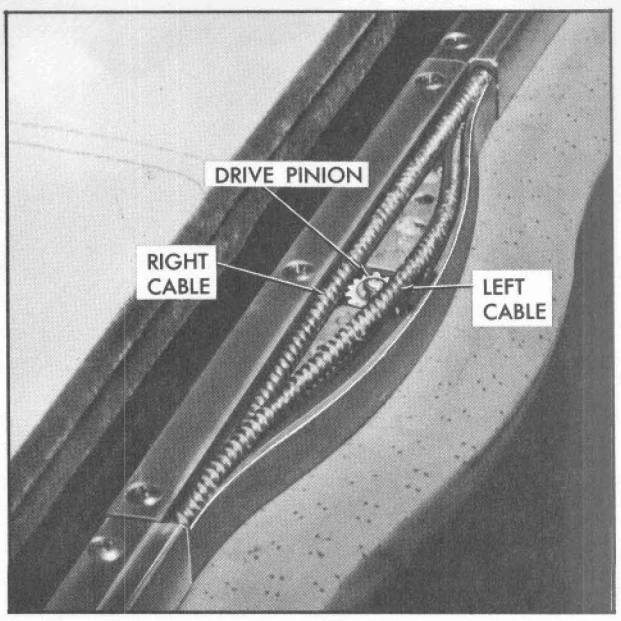


Fig. 15-53 Drive Cables Installed

4. Using a piece of flexible wire or cord, attach new hose to lower end of old hose and pull new hose into position while removing old hose.

5. Secure new hose to drain tube outlet with weatherstrip adhesive.

6. Install headlining, garnish moldings, sun visors, and bracket as described in Note 37b, Steps 11 and 12.

b. Rear Drain Hose

1. Pull down headlining at rear corner to gain access to hose.

2. Remove hose from drain tube outlet at top.

3. Using a piece of flexible wire or cord, attach new hose to lower end of old hose and pull new hose into position while removing old hose.

40. Weatherstrip Replacement

a. Removal

1. With Sunroof panel closed, mark joint of roof opening weatherstrip rear edge and roof panel weatherstrip front edge on both the roof panel and roof at both sides of vehicle.

2. Remove roof panel assembly from vehicle, as described in Note 38a.

3. Remove weatherstrips from roof panel opening and from rear edge of roof panel.

b. Installation

1. Clean surfaces using a suitable cement solvent.

2. Apply weatherstrip cement to both surfaces.

3. Position roof opening weatherstrip slightly below flush of roof and align one end of weatherstrip with mark on roof assembly. Cement weatherstrip to roof opening.

4. Install weatherstrip on rear edge of roof panel in same manner as roof opening weatherstrip described in Step 3.

(NOTE: Roof panel weatherstrip is also retained with trim nails.)

5. Install roof panel assembly into roof opening, as described in Note 38d.

41. Periodic Maintenance

a. Lubrication

1. During cable replacement, lubricate cables with #70 grade lubriplate or equivalent.

2. Periodically clean off any dirt that may have accumulated on guide rail covers.

CAUTION: Do not lubricate top surface of guide rail covers as this will cause streaks on headlining material.

b. Drain Tubes

1. During regular maintenance, check the two drain holes at the front corners of the roof panel, Fig. 15-30, to make certain they are open and free of foreign material. If drains are plugged, they can be cleaned with an air hose or flexible wire. If they cannot be cleaned in this manner, they must be replaced.

2. To clean rear drain tubes, use an air hose or flexible wire from the bottom of the tubes.

BOLT AND NUT IDENTIFICATION

BOLT STEEL CLASSIFICATION

G. M. MATERIAL NO.	HEAD MARKING	STRENGTH
260-M	 (None)	Standard
280-M	 (120°)	Medium
300-M	 (60°)	High

HEX-NUT STEEL CLASSIFICATION

G. M. MATERIAL NO.	MARKING	STRENGTH
Conventional Type		
286-M	  (None)	Standard
301-M	  USUAL (120°)	High
	  OPTIONAL (120°)	
Prevailing Lock Type (Stover)		
A	 (None)	Standard
B	 (120°)	Medium
C	 (60°)	High

DRILL SIZES

Letter Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches
Z	0.413	1	0.2280	28	0.1405	55	0.0520
Y	0.404	2	0.2210	29	0.1360	56	0.0465
X	0.397	3	0.2130	30	0.1285	57	0.0430
W	0.386	4	0.2090	31	0.1200	58	0.0420
V	0.377	5	0.2055	32	0.1160	59	0.0410
U	0.368	6	0.2040	33	0.1130	60	0.0400
T	0.358	7	0.2010	34	0.1110	61	0.0390
S	0.348	8	0.1990	35	0.1100	62	0.0380
R	0.339	9	0.1960	36	0.1065	63	0.0370
Q	0.332	10	0.1935	37	0.1040	64	0.0360
P	0.323	11	0.1910	38	0.1015	65	0.0350
O	0.316	12	0.1890	39	0.0995	66	0.0330
N	0.302	13	0.1850	40	0.0980	67	0.0320
M	0.295	14	0.1820	41	0.0960	68	0.0310
L	0.290	15	0.1800	42	0.0935	69	0.0292
K	0.281	16	0.1770	43	0.0890	70	0.0280
J	0.277	17	0.1730	44	0.0860	71	0.0260
I	0.272	18	0.1695	45	0.0820	72	0.0250
H	0.266	19	0.1660	46	0.0810	73	0.0240
G	0.261	20	0.1610	47	0.0785	74	0.0225
F	0.257	21	0.1590	48	0.0760	75	0.0210
E	0.250	22	0.1570	49	0.0730	76	0.0200
D	0.246	23	0.1540	50	0.0700	77	0.0180
C	0.242	24	0.1520	51	0.0670	78	0.0160
B	0.238	25	0.1495	52	0.0635	79	0.0145
A	0.234	26	0.1470	53	0.0595	80	0.0135
		27	0.1440	54	0.0550		

DECIMAL EQUIVALENTS

1/64	.015625	33/64	.515625
1/32	.03125	17/32	.53125
3/64	.046875	35/64	.546875
1/16	.0625	9/16	.5625
5/64	.078125	37/64	.578125
3/32	.09375	19/32	.59375
7/64	.109375	39/64	.609375
1/8	.125	5/8	.625
9/64	.140625	41/64	.640625
5/32	.15625	21/32	.65625
11/64	.171875	43/64	.671875
3/16	.1875	11/16	.6875
13/64	.203125	45/64	.703125
7/32	.21875	23/32	.71875
15/64	.234375	47/64	.734375
1/4	.25	3/4	.75
17/64	.265625	49/64	.765625
9/32	.28125	25/32	.78125
19/64	.296875	51/64	.796875
5/16	.3125	13/16	.8125
21/64	.328125	53/64	.828125
11/32	.34375	27/32	.84375
23/64	.359375	55/64	.859375
3/8	.375	7/8	.875
25/64	.390625	57/64	.890625
13/32	.40625	29/32	.90625
27/64	.421875	59/64	.921875
7/16	.4375	15/16	.9375
29/64	.453125	61/64	.953125
15/32	.46875	31/32	.96875
31/64	.484375	63/64	.984375
1/2	.5	1	

WEIGHTS AND MEASURES

LINEAR MEASURE

1/12 foot (ft.) ..... = 1 inch (in.)
12 inches ..... = 1 foot
3 feet ..... = 1 yard (1 yd.)

AREA MEASURE

1/144 square foot (sq. ft.) .. = 1 square inch (sq. in.)
144 square inches ..... = 1 square foot
9 square feet ..... = 1 square yard (sq. yd.)

LIQUID MEASURE

1/16 pint (pt.) ..... = 1 ounce (oz.)
1 pint ..... = 16 ounces
2 pints ..... = 1 quart (qt.) = 32 ounces
4 quarts ..... = 1 gallon (gal.)
31 1/2 gallons ..... = 1 barrel (bbl.)

DRY MEASURE

1/2 quart (qt.) ..... = 1 pint (pt.)
2 pints ..... = 1 quart (qt.)
8 quarts ..... = 1 peck (pk.)
4 pecks ..... = 1 bushel (bu.)
105 quarts ..... = 1 barrel

CUBIC MEASURE

1,728 cubic inches ..... = 1 cubic foot
27 cubic feet ..... = 1 cubic yard

COMMON WEIGHT

16 ounces ..... = 1 pound
100 pounds ..... = 1 hundred weight (cwt.)
2000 pounds ..... = 1 ton

COMMON U.S.A. EQUIVALENTS

LENGTH

1 inch ..... = 25.4001 millimeters
1 millimeter ..... = 0.03937 inches
1 foot ..... = 0.304801 meters
1 meter ..... = 3.28083 feet
1 yard ..... = 0.914402 meters
1 meter ..... = 1.093611 yards
1 mile ..... = 1.609347 kilometers
1 kilometer ..... = 0.621370 miles

LIQUID CAPACITY

1 quart ..... = 0.94633 liters
1 liter ..... = 1.05671 quarts
1 gallon ..... = 3.78533 liters
1 liter ..... = 0.26418 gallons

DRY CAPACITY

1 quart ..... = 1.1012 liters
1 liter ..... = 0.9081 quarts
1 peck ..... = 8.810 liters
1 liter ..... = 0.11351 pecks

Subject	Page No.
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